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# ANIMAL REMAINS FROM HARAPPA

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# ANIMAL REMAINS FROM HARAPPA

## CHAPTER I.—INTRODUCTION.

The collection of animal remains from Harappa, on which the present report is based, was sent to the Zoological Survey of India in several consignments and Lt.-Col. R. B. Seymour Sewell, the then Director of the Zoological Survey of India, proposed to deal with this collection on the lines of his report on the animal remains from Mohenjo-daro[1]. Owing to his going on long leave and other circumstances connected with his premature retirement from the department, he was unable to deal with the collection and I undertook to report on the Harappa animal remains at the request of my friend Rai Bahadur Daya Ram Sahni, then Director General of the Archæological Survey of India. The very short time allowed for the preparation of the report rendered the task very difficult, and it has involved a great deal of labour to review the extensive zoological, palæontological, historical and archæological literature on the subject and prepare a detailed account on the very large collection—almost four-to-five times the size of the animal remains from Mohenjo-daro—within the short space of less than 3 months.

The collection of animal remains from Harappa may roughly be divided into two lots: (1) Collections made under the supervision of Rai Bahadur Daya Ram Sahni during the field season of 1924-25; these are referred to in the report as "*D. R. S.* coll.;" and (2) the extensive collections made during the seasons 1925-26, 1927-28, 1929-30 and 1930-31 under the supervision of Mr. Madho Sarup Vats, the officer in charge of the explorations at Harappa. The human and animal remains from Area G were excavated during the seasons 1928-29 and 1929-30 by Dr. B. S. Guha, while in the field season of 1930-31 the collections were made and preserved in the field by Messrs. H. K. Bose and S. Sarkar, who were specially engaged by the Archæological Survey of India for carrying out the work of preservation of the human and animal remains under Dr. Guha's supervision.

In reference to the various sites, unfortunately no detailed plan indicating the exact areas where the collections were made has been available, and as I have not visited Harappa, I have had to rely on the old plan of the Harappa site published by Cunningham.[2] In this plan Mound AB is indicated as not

[1] *Mohenjo-daro and the Indus Civilization*, II, Chapter XXXI, pp. 649-673 (1931). In the Table of Contents on p. ix Dr. B. S. Guha's name has by mistake been associated with that of Col. Sewell as the joint author of this Chapter.

[2] *Archæological Survey of India, Report for the year 1872-73*, Vol. V, pl. xxxii (1875).

very far from the old bed of the River Ravi to the west of the present village of Harappa. Mound F has been described in the Annual Progress Report[1] for the year ending 31st March 1921 by Rai Bahadur Daya Ram Sahni as "the northernmost mound on the site". This site, as the detailed lists in the report shows, yielded very extensive collections of animal remains from various areas. For a description of the Great Granary area, which also yielded extensive series of animal remains, reference may be made to Vats.[2] The sites, Area G and Cemetery H, were not raised mounds like the Mounds AB and D, but low ground areas; a description of these sites has recently been published by Vats.[3] Further details about the various sites are not available, but accounts of these will presumably appear in the reports by the officers of the Archæological Survey of India who were responsible for the excavations. In reference to the relevant details of these areas, Mr. Madho Sarup Vats writes as follows in a letter: "The human remains at Harappa come from mound AB, area G, and the cemetery H. Of these, mound AB is later than mound F, but the IVth stratum in the former in which the remains were found is roughly contemporary with the two upper strata in the latter mound. Similarly Area G is later than mound AB, and the Cemetery H, which is the latest, is later than Area G." The above information is unfortunately not detailed enough for a complete analysis of the animal remains from various sites. These remains are only casually mentioned in the various reports referred to above, and no detailed chronology of the sites is, so far as I am aware, available. As the remains were examined by me only after they had been treated with shellac for preservation, it is impossible to surmise the relative ages of the finds from the different sites. All that can be stated definitely is that most of the animal remains excavated at Harappa, except in some cases where the bones appear to be recent, are contemporary with the animal remains from Mohenjo-daro described by Col. Sewell.

In most cases the animal remains from Harappa are very fragile, as is natural with bones that have remained buried under earth rich in saltpetre for a very long time—roughly 5,000 years. The organic material of the bones has completely disappeared and they are richly impregnated with gypsum. Small patches of the same substance were, as was also noted by Sewell, often found on the exposed surfaces of the bones. Burnt or charred bones are, as in the case of Mohenjo-daro remains, better preserved than those which had not undergone this process. The bones found in burial jars were also in a better state of preservation than those found buried under earth. Among the Harappa animal remains some of the long bones, such as humerus, radius, femur, tibia and cannon bones, were, in a few instances, obtained almost intact. The number of bones in the collection is very large, but as most of them consist of fragments, a fair number are of little use either for identification or for exact measurements.

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[1] Annual Progress Report of the Superintendent, Archæological Survey, Hindu and Buddhist Monuments, Northern Circle, for the year ending 31st March 1921, p. 9 (1922).

[2] *Archæological Survey of India, Annual Report 1926-27*, pp. 97-101 (1930).

[3] *Archæological Survey of India, Annual Report 1928-29*, pp. 80, 81 (1933).

In general, the bones excavated at Harappa resemble those of the collections made at Anau and described by Duerst[1] and those described by Sewell from Mohenjo-daro. As in the case of the Anau and Mohenjo-daro collections, there is a large number of bones which seem to have belonged to young animals which had been killed for food. The remains of such animals as the jackal and the wolf may have been introduced fortuitously or may be the result of the hunting of these animals by the Harappa people. The latter view would certainly hold for the only remain of the rhinoceros, *viz.*, the scapula, to which special attention may be directed (*infra*, pp. 30, 31). The other animal remains, with the exception of the invertebrates and the reptiles, all belong to those of domestic animals and in this report I have, therefore, paid special attention to tracing the probable ancestries and the areas of domestication of the various animals, the remains of which have been discovered at Harappa. These questions are generally reviewed in reference to various animals under their respective accounts, but a short summary of my conclusions is given in the next chapter.

In addition to the 3 specimens of the marine gastropod, *Galeodes* (*Hemifusus*) *pugilinus* (Born) and a coral, *Favia fabus* (Förskal), specimens of which from Harappa were identified by me for the authorities of the Archæological Survey on previous occasions, the number of species of animals represented in the present collections is 30. Of these there are 4 Invertebrates and 26 Vertebrates :

*Invertebrates.*

(1) *Viviparus bengalensis* (Lamarck).
(2) *Zootecus insularis* (Ehrenberg).
(3) *Parreyssia favidens* (Benson).
(4) *Lamellidens marginalis* (Lamarck).

*Vertebrates.*

(1) *Rita rita* (Ham. Buch.).
(2) Carp remains.
(3) *Varanus* sp.
(4) *Gavialis gangeticus* (Gmelin).
(5) *Geoclemys hamiltoni* (Gray).
(6) *Kachuga tectum* Gray, forma *typica*.
(7) *Lissemys punctata* (Bonnaterre) forma *typica*.
(8) *Chitra indica* (Gray).
(9) *Trionyx gangeticus* Cuvier.
(10) *Gallus* sp.
(11) *Felis ocreata* Gmelin, race *domestica* Brisson.
(12) *Mungos auropunctatus* (Hodgson).
(13) *Canis indicus* Hodgson.
(14) *Canis pallipes* Sykes.
(15) *Canis tenggeranus* Kohlbrugge, race *harappensis*, nov.
(16) *Tatera indica* (Hardwicke).
(17) *Rattus rattus* (Linn.).
(18) *Bos indicus* (Linn.).
(19) *Bos* (*Bubalus*) *bubalis* (Linn.).
(20) *Equus asinus* Linnæus.
(21) *Rhinoceros unicornis* Linnæus.
(22) *Capra ægagrus* Gmelin, race *indicus*.
(23) *Ovis vignei* Blyth, race *domesticus*.
(24) *Cervus* (*Recurvus*) *duvauceli* Cuvier.
(25) *Sus cristatus* Wagner var. *domesticus* Rolleston.
(26) *Camelus dromedarius* Linnæus.

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[1] Duerst, J. U.—"Animal Remains from the Excavations at Anau" in *Explorations in Turkestan, Prehistoric Civilization of Anau*, II, pp. 341-442, pls. lxxi-xci, (Washington, 1908).

The number of species represented in the collection from Mohenjo-daro was 37; some of these species, however, were not indigenous to that area but had been imported either for the manufacture of ornaments or for medicinal purposes. Several of the species in the two collections are identical, while some like the elephant, the horse, the shrew, a number of species of stags and deer are not represented in the collection from Harappa. On the other hand, the monitor lizard, the cat, the jackal, the wolf, the domestic ass, the rhinoceros, and the goat, remains of which have been found at Harappa, were not represented in the Mohenjo-daro collection.

Amongst the invertebrates the banded pond-snail, *Viviparus bengalensis*, and the land-snail, *Zootecus insularis*, are apparently of quite recent origin. The former may have been washed in with innundations from the River Ravi, while the land-snail had apparently crawled within quite recent times into the jar where it was found, and cannot be considered as contemporaneous with the Harappa date. The two species of freshwater mussels are undoubtedly of the same age as the other remains of animals from Harappa, and probably the shells of these mussels were used by the inhabitants either for ornamental purposes or as spoons, etc. The only valve of the mussel *Parreyssia favidens* (Benson), it may be noted, was found in a burial jar.

As is shown by the records of the finds at Harappa, the remains of several animals, such as the mongoose, the Indian Gerbille or Antelope rat, the common rat, the domestic ass, the cattle, the sheep, the Barasingha, and the camel, were found in burial jars or troughs. The common rat and the Gerbille may have wandered into the jars before these were closed, but the bones of other animals must have been purposely placed in the jars. It is not possible to surmise their exact significance except possibly considering them as relics of offerings to the dead.

In working out this collection I have received a great deal of help from my colleague Dr. B. S. Guha. The Archæological assistant, Mr. H. K. Bose, M.Sc., who, as noted above, was responsible for the preservation of some of the remains in the field season of 1930-31, and the remainder in the laboratories of the Zoological Survey of India, rendered invaluable help in correlating the numbers on the bones with the lists of the finds and localities supplied by the Archæological Survey. Babu P. N. Mitra, Taxidermist of the Zoological Survey of India, has also helped me in the routine work connected with the identification of the collection. The photographs of the animal remains were taken by Babu Subodh Ch. Mondul under my supervision, and Babu D. N. Bagchi has prepared the illustrations of the teeth of the Antilope rat and the pig; I am indebted to them for the careful way in which they have prepared the illustrations.

## CHAPTER II.—ANCESTRIES AND CENTRES OF DOMESTICATION OF THE HARAPPA ANIMALS.

In view of the recent detailed discussion by Antonius[1] of the importance of the study of ancient history and archæology for a history of the evolution of different types of domestic animals during various epochs, the successions of the numerous races and their connections with the primitive societies and prehistoric cultures of various centres, it is not necessary again to cover the same ground. The archæological "sources" rather than "methods of study", as the author rightly points out, provide us with very valuable data in connection with the past history of the domesticated animals, though they are also responsible for numerous hasty and unwarranted conclusions regarding the possible dates of domestication.

Most authorities agree that the date of "Haustierkultur" of Europe, as Antonius terms it, was at the latest 6000 B.C. In reference to North-west Africa, Central and South-east Asia, however, which areas undoubtedly played a very important part in this connection, our information is very scanty. Pumpelley's excavations in Turkestan yielded very important results, but the account of the animal remains of this area by Duerst (*loc. cit.*) very valuable as it is, has rightly been criticised by Antonius (*loc. cit.*, p. 11). This author's table of dates, a translation of which I reproduce below, shows the vast differences between the ages assigned to the different cultures by Duerst and other authors:

| | Pumpelly (Duerst). | Schmidt. | Christian. |
|---|---|---|---|
| Beginning of Culture I . . | 9000 B.C. . . . | 3000 B.C. . . . | *ca.* 5500 B.C. |
| Domestication of animals . | *ca.* 8000 B.C. . . | .... | .... |
| Beginning of Culture II (Stone—Copper Age). | *ca.* 6000 B.C. . . | 2000—1500 B.C. . . | *ca.* 4500 B.C. |
| Beginning of Culture III (Copper Age). | *ca.* 5200—2200 B.C. . | *ca.* 1500—*ca.* 1000 B.C. . | *ca.* 4000—2500 B.C. |
| Beginning of Culture IV (Iron Age). | *ca.* 450 B.C.—150 A.D. . | 1000—500 B.C. . | .... |

Unfortunately no detailed accounts of any prehistoric animal remains from Mesopotamia, Persia, Syria or Egypt have been published so far, and it is, therefore, impossible to correlate the animal remains from Mohenjo-daro and Harappa with those of the adjacent areas.

Sir John Marshall[2] considered the Mohenjo-daro antiquities to be as old as 3250 B.C., but added that the culture represented in this area "must have had a long antecedent history on the soil of India." The domestication of various breeds of animals, such as dogs, cattle, goats, sheep, donkey and camel[3] which

[1] Antonius, A.—*Grundzüge einer Stammesgeschichte der Haustiere*, pp. 9-13 (Jena, 1922).

[2] Marshall, Sir John.—*Mohenjo-daro and the Indus Civilization*, I, p. 106 (London, 1931).

[3] The possibility of some of these domestic animals having been imported into the Sind Valley has also to be considered, but most of these forms were certainly domesticated in this valley independently.

have been found at Mohenjo-daro and Harappa could not have been accomplished in a few hundred years. The domestication of animals and the high grade of agricultural activities carried on by the progenitors of the Indus civilization would antedate the evolution of such activities by a couple of thousand years at the very least. This hypothetical date, and it can be nothing more than hypothetical with the present state of our knowledge, would bring the date of domestication of the different animals in line with Christian's modifications of Pumpelly-Duerst's dating of the domesticated animals from Anau (*antea*, p. 5). The earlier culture of Mohenjo-daro and Harappa, which may be designated as the Chalcholithic or Stone-Copper Age, it may be remarked, appears from the study of the animal remains to be contemporaneous with Anau Culture II of Pumpelly-Duerst.

As this stage the cattle as can be inferred from their beautiful representations on seals and other objects and the *terra-cotta* figures excavated at Mohenjo-daro and Harappa, had already been domesticated.

Hilzheimer[1] rightly considers the domestic cattle as the basis of our present day civilization, and, in admitting that the development of agricultural pursuits was rendered possible only through this agency, seems to suggest that their domestication must have been antecedent to man taking to agricultural activities. Hahn's remarks[2] quoted by Hilzheimer "Als diese Erwerbung (domestication of cattle) vollzogen war, als man milch trank und den Ochsen vor den Pflug spannte, warren wesentlich alle Erwerbungen für unsere asiatisch-europäische Kultur vorhanden", are also very significant in this connection. Mucke[3], on the other hand, in his theory of domestication contends that domestication could not have been accomplished by people in the hunting stage and that in the earlier times the breeders of cattle and cultivators of the soil were two separate entities. Further, however, he suggests that the wild animals in quest of food came spontaneously to the dwellings of the primitive inhabitants, from which it has to be inferred that these people were agriculturists for, as Duerst (*loc. cit.*, p. 437) rightly points out, ruminants like oxen and sheep could not have been "attracted by meat or other products of hunting and fishing life". Consequently Duerst is of the opinion that "agricultural state of human development must also have preceded the state of cattle breeders". Though it is impossible to dogmatise about the exact sequence of events, one would be justified in presuming that whereas in the earlier stages primitive agriculture might have antedated domestication of animals, its further development and evolution to the stage at which it had reached in the Indus Valley, could not have been possible without the domestic cattle. Probably the two processes went on in the Sind Valley simultaneously over a long period of time before reaching the stage of culture which Sir John Marshall considers to be as ancient as 3250 B.C.

In reference to the origin of the various Indian domestic animals there can be no question that several of them are the descendants of the very rich

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[1] Hilzheimer, M.—*Die Säugethiere* in *Brehms Tierleben* (4th edn.), IV, p. 334 (Leipzig & Wien, 1920).
[2] Hahn, E.—*Die Haustiere und ihre Beziehungen zur Wirtschaft der Menschen* p. 75 (Leipzig, 1896).
[3] Mucke, J. R.—*Urgeschichte der Ackerbaues und der Viehzucht*, p. 256 (Griefswald, 1898).

mammalian Siwalik Fauna of the Indian Tertiaries. The Indian buffalo and the camel are so closely allied to the Siwalik forms that their ancestry can not be doubted. Most recent authorities also agree that the Indian humped cattle are to be derived from the Siwalik Nerbuddah Ox, *Bos namadicus* Falconer (*vide infra*, pp. 40 43).

The cat and the ass appear to be Æthiopian in origin and probably migrated to India during the Pliocene times along Jacobi's Arabian and Persian Regions of dispersal[1]. The Arabian region of dispersal extended from North-eastern Africa across Arabia and along the mouth of the Persian Gulf, and Jacobi considers this to be the main route along which the interchange of the Siwalik with the Æthiopian fauna took place. Sarasin[2] following Oldham and other geologists considers the Oligocene or the Miocene to the Pleistocene to be the period when India was broadly connected with North Africa and South-eastern Europe over Baluchistan, Persia, Arabia and Turkey, and believes that the main migration of the Siwalik Fauna took place along this land connection about this time. Such an interchange has again very recently been advocated by Marcus[3] who concludes "Die Siwalikfauna enhält die Hauptmasse der heutigen Æthiopischen Tierwelt, die in das offener gewordene Afrika von Norden und Nordosten einwanderte". He further adds that the connection between the Oriental and the Æthiopian Regions from Syria over Arabia to the Nile Valley was broken along the Red Sea Zone in Upper Pliocene and along the Straits of Bab-el-Mandeb in Pleistocene times. In addition to these earlier routes of dispersal there appears to have been a great deal of interchange and earlier introduction of new animals about 2000 B.C. along a route which Antonius (*loc. cit.*, p. 188) traces from India over the Persian Gulf to the old trade centres on the banks of the Euphrates and over the caravan routes along the present day Baghdad and Syrian Railway to Aleppo, Hama and Damascus and from there over the Lebanon to North Africa. The cat and the ass may have migrated to India about the end of the Tertiary times, but there appears more likelihood of their having been introduced at a later date through human agency, probably with tribal migrations.

As the animal remains at Harappa were not obtained in sharply marked off strata or in successions at relatively distinct depths, it is impossible to construct a hypothetical sequence for the appearance of the various species of animals such as was attempted for the Anau Forms by Duerst (*loc. cit.*, pp. 436, 437). In the following paragraphs I give a summary of my ideas in reference to the various types of domestic animals which have been found at Harappa.

*Cat.*—Sir John Marshall (*loc. cit.*, p. v) stated that the cat was not known to the inhabitants of the Sind Valley and no remains of this animal were found at Mohenjo-daro. In the collection of animal remains from Harappa, however,

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[1] Jacobi, A.—*Zeitschr. Gesselsch. Erdkunde Berlin*, XXXV, pp. 321-426 (1900). Jacobi's map of the regions of dispersal is also reproduced by Meisenheimer in *Handwörterbuch Naturwiss.* X, p. 976 (Jena, 1915).

[2] Sarasin, F.—*Zool. Jahrb. Suppl.* XII, p. 82 (1910).

For a detailed discussion of these connections see also Prashad, B.—*Mem. Ind. Mus.* VIII, pp. 231-234 (1928).

[3] Marcus, E.—*Tiergeographie* (Sonderabdruck aus dem Handbuch der Geographiscen Wissenschaft), p. 146 (Potsdam, 1933).

there are a number of bones of cat excavated at depths of 3′ 10″ to 5′. These remains are fairly well preserved and appear to be fairly ancient. Though it would be rash to assign them definitely to any particular age, I am of opinion that they are contemporaneous with other animal remains found at Harappa. As is discussed further on (*infra*, pp. 16, 17), there is a general consensus of opinion that the ancestor of the Domestic Cat was the African *Felis ocreata* Gmelin, and the Indian Domestic Cat is also to be derived from this ancestral form, but the exact date at which the cat took its place amongst the domestic animals in India can only be roughly surmised as some time during the Indus Valley civilization.

*Dog.*—Sir John Marshall (*loc. cit.*, p. 38) from the *terra cotta* figures of the dog and the finely carved steatite figure of a hound excavated at Mohenjo-daro concluded that there were probably two distinct types of dog domesticated by the Indus people: (1) a type akin to the Pariah, and (2) a more highly bred dog allied to the modern mastiff. The only remains of the dog from Harappa are of the greyhound-type, with an elongated snout; I consider this type to be allied to *Canis tenggeranus* Kohlbrugge. As is discussed further (*infra*, pp. 25, 26), this type, which had a wide distribution in the Oriental Region in the Diluvial times, was the ancestor of the Pariah, while through domestication and human agency the greyhound, the Tibet Dog and probably other races of dogs were evolved from it. The Harappa Dog, for which I have proposed the name *C. tenggeranus* race *harappensis*, also shows, in the shape of its skull, distinct affinities to that of the Indian Wolf, *C. pallipes*, and so far as can be inferred from the scanty remains, was probably the ancestral form of the Indian greyhound. The remains of the Harappa Dog are comparatively very ancient, particularly those from Mound AB, and I believe that this animal must have been domesticated in the Valley at a fairly early date in the course of the Indus civilization.

*Ass.*—The Domestic Ass, the remains of which have been found at Harappa, is, in view of its close relationship with the African species, to be considered as having been imported to the Indus Valley from Africa, probably along Jacobi's Arabian and Persian Region of dispersal (*supra*, p. 7).

*Ox.*—As is discussed further, two types of Cattle—the humped (Zebu) and the humpless—can be distinguished in the representations on seals and other objects found at Mohenjo-daro and Harappa. I agree with Duerst that the short-horned, humpless type originated as a result of the decline of cattle breeding in the Valley from the long-horned, humped cattle, and is not to be considered as a new race which was imported from outside. The long-horned humped cattle I consider to be the descendants of *Bos namadicus* Falconer and its earlier progenitor *B. primigenius* Rütimeyer of the Siwalik Fauna.

*Buffalo.*—There is a general consensus of opinion that the Indian Buffalo is the direct lineal descendant of the gigantic *Bubalus palæindicus* Falconer, of the Pliocene Age, and I am of opinion that one of the centres, if not the sole centre, of its domestication in India was the Sind Valley. Unfortunately very few remains of this animal were recovered from either Mohenjo-daro or Harappa, but

even with this material there can be no doubt that this animal, as Sir John Marshall also suggests (*loc. cit.*, p. v), had been domesticated by the Indus Valley inhabitants.

*Goats.*—As is discussed further (pp. 48, 49), the ancestry of the Indian Domestic Goats is somewhat uncertain, but they can provisionally be considered as derived from the Pasang—*Capra ægagrus* Gmelin, and probably the inhabitants of the Indus Valley played an important part in domesticating this animal.

*Sheep.*—With our present knowledge of the domestication of the Sheep it is not possible to dogmatise about the origin of the various races of Indian Sheep, but, as is suggested further on (*infra*, pp. 51, 52), the Urial, *Ovis vignei* Blyth the range of which extends to the Indus Valley, is probably the ancestor of the Domestic Sheep found at Mohenjo-daro and Harappa. I have, therefore, provisionally designated the Harappa Sheep as the race *domesticus* of *Ovis vignei* Blyth.

*Pig.*—The Indian pig *Sus cristatus* Wagner, which is closely allied to the widely distributed species *S. vittatus* Müller & Schlegel, was probably derived from the *vittatus*-stock. The Domestic Pig found in the Indus Valley may have been domesticated from the wild boar common in this area or might have been imported from the adjacent regions.

*Camel.*—The Indian one-humped camel is undoubtedly the descendant of the Siwalik fossil form, *C. sivalensis* Falconer and Cautley, and there seems every reason to suppose that the domestication of this animal was first brought about in India and probably in the Indus Valley.

Blanford[1] writing in 1877 remarked, "It has long been known that we are probably indebted to the early inhabitants of India for two domestic animals, the buffalo and the peacock; the origin of the humped cattle is obscure, and the common fowl appears to be descendant of the Burmese and not of the Indian race" of the wild fowl. Jeitteles,[2] however, suggested that some of the most valued races of European dogs are of Indian origin. In view of what has been stated above it would not be far wrong to consider India as having been a very important centre for the domestication not only of the buffalo, but also of the dog, the cattle, the sheep, the goat and the camel.

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[1] Blanford, W. T.—*Proc. As. Soc. Bengal*, p. 117 (1877).

[2] Jeitteles, L. H.—*Die Stammväter unserer Hunde-Rassen*, pp. 28-35 (Wien, 1877).

# CHAPTER III.—SYSTEMATIC DESCRIPTION OF THE COLLECTION.

## (a) INVERTEBRATA.

Phylum: **Mollusca.**

Class: GASTROPODA.

Sub-class: STREPTONEURA.

Order: *PECTINIBRANCHIA.*

Family: VIVIPARIDÆ.

### Viviparus bengalensis (Lamarck).

The Banded Pond-snail.

Mound F; Great Granary area; Square J 9/10; depth 11′ 9″. 10 shells.

The common Banded Pond-snail of India is widely distributed in India and Burma, and is found in ponds, lakes, rivers, etc. Several races of this very variable and plastic species have been described from different parts of India, and the common race of north-western India is *mandiensis* Kobelt[1]. The distinguishing characters of this race are clearly indicated in Annandale's account and figures. The specimens from Harappa do not differ in any material points from Annandale's description. The largest shell is 32 mm. long with a maximum diameter of 22 mm. across the body-whorl.

*Distribution.* The range of race *mandiensis*, according to Annandale, "extends from Allahabad at the junction of the Jumna with the Ganges to the northern limits of the Punjab on one hand and to the shores of the Arabian Sea at Bombay on the other."

Sub-class: EUTHYNEURA.

Order: *PULMONATA.*

Family: ACHATINIDÆ.

### Zootecus insularis (Ehrenberg).

7853a. Mound F; Great Granary area; Square I 9/3; depth 7′ 2″. "Out of Jar No. 7853". One shell.

This land-snail has a very wide range throughout India and Burma, and for a detailed list of localities reference may be made to Gude[2]. Outside the Indian region *Z. insularis*, according to Pilsbry[3] is found from the Cape Verde Islands and Senegambia eastwards to Egypt, Abyssinia, Southern Arabia to Baluchistan.

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[1] Kobelt, W.—in *Martini-Chemn. Conch. Cab.* (N. F.), II (Abth. 21a), *Paludina*, p. 414, pl. lxxvii, figs. 8, 9 (Nürnberg, 1909). See also Annandale, N.—*Rec. Ind. Mus.* XXII, p. 271, pl. i, figs. 4, 10 (1921).

[2] Gude, G. K.—*Fauna Brit. Ind., Moll.*, II, *Trochomorphidæ-Janellidæ*, pp. 367-369 (London, 1914). For a figure of this species see Hanley, S. & Theobald, W. T.—*Conch. Ind.*, pl. xxii, fig. 10 (1870).

[3] Pilsbry, H. A.—*Man. Conch.* (Ser. 2) XVIII, p. 106 (Philadelphia, 1906).

The single shell from Harappa appears to be a fairly recent specimen, and may have crawled into the jar where it was found. The periostracum is preserved over the greater part of the shell, and the sculpture, consisting of fine, close, subvertical striæ, a little bent near the suture, can be made out easily. The shell consists of 8 whorls and is 9·5 mm. long with a diameter of 3·5 mm. above the aperture.

## Class: PELECYPODA.

### Order: *EULAMELLIBRANCHIA*.

#### Family: UNIONIDÆ.

**Parreyssia favidens** (Benson).

(Plate I, fig. 1.)

3689. Mound AB; Extension of Pits I, II; Square P 24/23; depth 8′ 8″. "Out of jar No. 3689". A single right valve.

This species of freshwater mussel has a wide range of distribution in northern India, and is not found in the "Upper Ganges" only, as the author of the species believed. It is a very variable species and several varieties of it were described by Benson. Thanks to the courtesy of Prof. Stanley Gardiner, F.R.S., I have now had an opportunity of examining Benson's types of the various varieties preserved in the Zoological Museum of the Cambridge University, and hope to deal with these forms in a separate work. It is only necessary to note here that the single right valve excavated at Harappa is absolutely similar to the var. *trigona*[1] Benson described from Nujeebabad in the north-west of Rohilkhand. The single valve, which I figure, is 30 mm. long × 22 mm. high. It is in a fair state of preservation, but there is no trace of the periostracum.

The occurrence of this freshwater mussel in a burial jar definitely indicates that it must have been buried with other remains.

**Lamellidens marginalis** (Lamarck).

Mound F; Great Granary area; Square J 9/5, 10 & 15; depth 3′—5′. A fragment of a right valve.

Mound F; Great Granary area; Square K 9/1-5; depth 6′—9′. Fragments of a left valve.

This freshwater mussel, which grows to a fairly large size among the commoner forms of India, is widely distributed throughout India, Burma and Ceylon. It is fairly common in the Punjab, in rivers, small lakes and even marshes, and shells of it are generally used either as spoons or for pealing green mangoes.

The Harappa shells are all incomplete and greatly worn, but I have no doubt as to their being typical shells of *L. marginalis*[2].

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[1] Benson, W. H.—*Ann. Mag. Nat. Hist.* (Ser. 3) X, p. 188 (1862). Also see Simpson, C. T.—*A Descriptive Catalogue of the Naiades*, pp. 1109, 1110 (Detroit, 1914).

[2] See Preston, H. B.—*Faun. Brit. Ind., Freshw. Moll.*, pp. 175, 176 (1915) and Simpson, *loc. cit.*, p. 1168. For a figure of the species see Hanley & Theobald, *loc. cit.*, pl. xliii, fig. 2.

## (*b*) VERTEBRATA.

### Class: PISCES.

#### Order: *TELEOSTEI.*

7841*a*. Mound F; Great Granary area; Square I 9/10; depth 3′ 10″; "Out of a trough." 3 Teleostean vertebræ.

7851*a*. Mound F; Great Granary area; Square I 9/3; depth 3′ 10″; "From a very fragmentary jar". One complete vertebra.

7849*a*. Mound F; Trench III, Square N 9/15; depth 10′ 3″; "From a very fragmentary jar". One abdominal vertebra.

7185. Mound F; Great Granary area; Square J 9 10; depth 11′ 9″. Incomplete pectoral spine of ? *Rita rita* (Ham. Buch.).

Mound F; Trench III; Square N 9/4, 9; depth 9′ 6″. Two vertebræ.

Mound AB; Extension of Pits I, II; Square Q 24/8; depth 8′. A mass of Teleostean abdominal and caudal vertebræ.

Mound AB; Extension of Pits I, II; Square Q 24/9; depth 10′. Several Teleostean vertebræ.

2201. Rubbish Heap. 2 Pectoral and one dorsal spines of *Rita rita* (Ham. Buch.).

1211. P 24/22. ? Vertebræ, ribs and opercular bits of Teleosteans.

The above listed remains are, with the exception of the spines of the catfish *Rita rita* (Ham. Buch.) from Mound F and a rubbish heap, too fragmentary to allow of more correct identification. Some of the vertebræ appear to belong to some species of carp, but it is impossible to identify them generically.

The fish-remains were in several cases found in troughs or fragmentary jars and this seems to suggest that they were probably buried with the other human or animal remains found in these earthen receptacles.

### Class: REPTILIA.

#### Order: *SQUAMATA.*

#### Sub-order: *LACERTILIA.*

Family: VARANIDÆ.

**Varanus** sp.

Monitor Lizard.

(Plate I, fig. 2.)

1400. Mound F; Pit III; Square N 9/9; depth 5′. A caudal vertebra.

Only a single caudal vertebra, which is reproduced as fig. 2 on plate I, is available. I have no doubt that it is a caudal vertebra of a Varanid probably of *Varanus griseus* (Daud) or *V. flavescens* (Gray)[1], both of which are commonly found in the Punjab and Sind. It is procœlous and the facets for the junction of the chevron bone, which is missing, are prominent.

[1] See Boulenger, G. A.—*Faun. Brit. Ind., Reptilia and Batrachia*, pp. 163, 164 (1890). See also Smith, M. A.—*Faun. Brit. Ind., Reptilia and Amphibia*, II, pp. 400, 404 (1935).

Order: *LORICATA.*

Family: CROCODILIDÆ.

**Gavialis gangeticus** (Gmelin).

The Gharial.

(Plate I, fig. 3.)

7048. Mound F; Great Granary area; Square J 9/15; depth 11′ 9″. A single dorsal scute.

The only remain of the Gharial amongst the bones excavated at Harappa is a dorsal body-scute (105 mm.×75 mm.×15 mm.). The size and thickness of the scute (Plate I, fig. 3) indicate that the animal must have been over 18 feet in length.

*Distribution.* According to M. Smith[1] *G. gangeticus* is found in "the Indus, Ganges, Mahanadi and Brahmaputra Rivers and their tributaries, and the Kaladan River, Arakan". Sewell also recorded the remains of this species from Mohenjo-daro (*loc. cit.*, p. 662).

Order: *TESTUDINES.*

Family: EMYDIDÆ.

**Geoclemys hamiltoni** (Gray).

3929. Mound F; Great Granary area; Square I 9/7; depth 10′ 2″. Part of a plastron.

A part of a plastron is referred to this species, with some hesitation. It is a squarish fragment and does not show any characteristic structure, but on comparison of the fragment with plastra of this species in the Indian Museum collection, I believe the above identification to be correct.

*Distribution.*—According to M. Smith (*l. c.*, p. 112) the range of this species is "Northern India from Sind to Bengal". Sewell (*l. c.*, p. 663) recorded remains of this species from Mohenjo-daro under the name *Damonia hamiltoni*.

**Kachuga tectum** Gray, forma **typica.**

D. S. 40. A(*c*). From an earthen jar (*D. R. S.*, coll.). Fragment of plastron.

3868. Mound AB; Pits I, II; Square Q 24/15; depth 8′ 11″, "out of trough 3868". Large number of fragments of carapace and plastron.

The large number of triangular to squarish fragments of the carapace and plastron from trough No. 3868 excavated at AB site and the other fragments from an earthen jar without definite provenance are all those of *Kachuga tectum* Gray, forma *typica*[2]. The very fragile nature of the fragments indicates their great antiquity.

*Distribution.*—According to M. Smith this species is found in "Northern India—the Ganges, Brahmaputra and Indus river systems". Fossils of this species have also been found in the Pleistocene of the Siwalik Hills.

[1] Smith, M.—*Faun. Brit. Ind., Reptilia and Amphibia*, I, p. 39 (1931).

[2] Smith, M.—*loc. cit.*, pp. 126-128.

Family: TRIONYCHIDÆ.

### **Lissemys punctata** (Bonnaterre), forma **typica.**

(Plate I, fig. 4).

5556. Mound F; Great Granary area; Square K 9/5; depth 12′ 6″. **Left epiplastron.**

The single left epiplastron, which I figure, is undoubtedly that of a medium-sized individual of *L. punctata* forma *typica*.

Remains of this species were recorded by Sewell (*op. cit.*, p. 663) from Mohenjo-daro under the name *Emyda granosa*.

*Distribution.*—According to M. Smith (*loc. cit.*, p. 158), the forma *typica* of *L. punctata* is found in "The Ganges and Indus and their tributaries". It has also been recorded from Sikkim, Akyab and from Jergo Island off the coast of Arakan.

### **Chitra Indica** (Gray).

(Plate I, fig. 5.)

D. S. 40, A(*e*). ? From an earthen jar (*D. R. S.*, coll.). **Fragment of plastron.**

146. Mound F; Great Granary area; Square M 11/15; depth 5′—5′ 8″. **Fragment of hypoplastron.**

2596. Mound F; Great Granary area; Square I 9/8; depth 6′ 4″. **Fragment of hypoplastron.**

10212. Mound F; Trench I; Square M 12/9; depth 9′ 10″—10′ 6″. **Fragment of hypoplastron.**

3124. Mound F; Great Granary area; Square I 9/18; depth 13′ 6″. **Fragment of hypoplastron.**

2037. Mound AB; Extension of Pits I, II; Square R 24/1; depth 14′ 2″. **Fragments of hypoplastron.**

265. Mound AB; Extension of Pits I, II; Square Q 24/2; depth 2′. **Fragments of hypoplastron.**

F V/IV. ? Fragment of hypoplastron.

Several fragments of hyo- and hypoplastron excavated in the site, Mound F, at depths varying from 5′—14′ 2″ indicate that this species of turtle was caught and probably used as food by the old inhabitants of Harappa at all times; the different levels probably correspond to the succession of various periods. The remains from the Mound AB appear to be more recent and so are the fragments numbered A(*e*) and 265 from Mound AB excavated from a depth of 2 feet, but those bearing the number F V/IV appear to be contemporaneous with those excavated from the Mound AB from a depth of over 14 feet.

Almost all the fragments show characteristic vermiculations and pittings which are coarser than those normally found on the plates of the plastron of *Trionyx gangeticus* Cuvier. I figure one of the fragments (Plate I, fig. 5).

*Distribution.*—According to M. Smith (*l. c.*, p. 163) *C. indica*, the largest of the Indian Trionychids, is found in "Northern India; Siam; the Malay Peninsula. Falconer obtained it in Nepaul". I[1] definitely recorded the species from the Indus System for the first time in 1914, and Sewell (*op. cit.*, p. 663) recorded remains of it from Mohenjo-daro.

[1] Prashad, B.—*Rec. Ind. Mus.*, X, p. 268 (1914).

**Trionyx gangeticus** Cuvier.

Mound F; Trench I; Square M 11/8; depth 17′ 3″. Several fragments of Hyo-, Hypo- and Xiphiplastron.

All the fragments excavated from a depth of 17′ 3″ in Mound F appear to belong to a half-grown individual of *T. gangeticus*. The fragments are fragile, and richly impregnated with gypsum.

*Distribution.*—According to M. Smith (*l. c.*, p. 168) this species is found in "The Indus, Ganges and Mahanaddi and their tributaries"

Class: AVES.

CARINATÆ.

Order: *GALLINÆ.*

**Gallus** sp.

(Plate I, figs. 6-9.)

Mound F; Great Granary area; K 9/1-5; depth 6′—9′. Right humerus; fragment of left femur.

The right humerus from Mound F agrees closely in general form with the corresponding bone of the domestic fowl. It is, however, a little longer, the length of the humerus from Harappa is 73 mm. whereas in a domestic fowl of Bengal the humerus is 61 mm. long. Sewell (*op. cit.*, p. 662) recorded the find of the head of a humerus from Mohenjo-daro. I have examined this specimen and find that it is the head of the left humerus and apparently belonged to a much bigger specimen than the Harappa specimen recorded here. The head of the Mohenjo-daro humerus is fully 2 mm. broader, more convex and with the tuberosities better developed. I reproduce natural size photographs of the two specimens (Plate I, figs. 6, 7).

The left femur fragment consists of the proximal part. It is about twice the size of that of a domestic fowl from Bengal. I reproduce natural size photographs of the two specimens (Plate I, figs. 8, 9).

Class: MAMMALIA.

Order: *CARNIVORA.*

ÆLUROIDEA.

Family: FELIDÆ.

**Felis ocreata** Gmelin, race **domestica** Brisson.

The Domestic Cat.

(Plate II, figs. 1, 2.)

1202. Mound F; Great Granary area; Square J 8/2; depth 5′. Part of the skull without the jaws and the left tympanic bulla.

7851*a*. Mound F: Great Granary area; Square I 9/3; depth 3′ 10″. Left humerus.

The skull of the cat excavated from the site indicated above is in a fair state of preservation and its incomplete condition does not seem to be connected with

its age. The skull, which I figure (Plate II, figs. 2, 2a) shows the well developed sagittal and lambdoidal crests, the greatly swollen parietal region and the prominent tympanic bulla, and agrees almost exactly with that of an Indian Domestic Cat in the collection of the Indian Museum, photographs of which are reproduced for comparison (Plate II, figs. 1, 1a). The only difference between the two skulls and which I consider to be only an individual variation, is in the slightly narrower post-orbital process of the frontal in the Harappa specimen. The skull from Harappa also agrees in all essential details with the beautiful diagrams of the skull of the European Domestic Cat published by Mivart[1]. The left humerus is typical and does not call for any remarks.

The nomenclature and origin of the Domestic Cat have been the subject of a great deal of speculation by zoologists, archæologists, ethnologists and even philologists, and for detailed discussion of the views of these authors reference may be made to Hilzheimer[2] and Pocock[3]. Pocock dealing with the English Domestic cats in particular concluded that there are two types of cats, (*i*) with a pattern of stripes in the form of "narrow transverse or vertical bands which sometimes break up into spots," and (*ii*) with a pattern of stripes in the form of "longitudinal or obliquely longitudinal bands forming a ring-like or spiral arrangement on the sides of the abdomen". The Domestic Cats of the second type were, according to Pocock named *Felis catus* by Linnæus. Though considering their origin as doubtful, he was inclined to the view that the Domestic Cats were dimphoric in pattern and that there were two distinct species of them in Europe. Hilzheimer, on the other hand, believes in a monophyletic origin for the Domestic Cat which he connects with a wild cat of the Pliocene period of South France. According to Max Weber[4] the ancestor of the Domestic Cat was not the wild cat but the African *Felis ocreata* Gmelin; both the forms, however, and the Asiatic cat of the Steppes are connected with one another by intermediate forms of the Mediterranean Region; this conclusion was apparently reached by Hilzheimer in 1912[5]. The Domestic Cat *Felis ocreata domestica* Brisson=*Felis catus* Linn., was, according to Hilzheimer and Weber, originally domesticated in Egypt where it was regarded as a sacred animal.

In reference to the Indian Domestic Cats, Blyth[6] remarked that two types of them were common in India, (*i*) streaked or spotted type, and (*ii*) uniformly cat-grey without any trace of spots or stripes, and resembling the Jungle Cat, *F. chaus* in colour. Sclater[7] discussed the two types and accredited Blyth with the view that the self-coloured *chaus*-like type was derived from interbreeding between the Domestic Cat and *F. chaus*. Pocock (*loc. cit.*, pp. 164, 165) after discussing the views of these two authors concluded that "there is nothing to distinguish them from *F. ocreata*" and that "they have been derived

[1] Mivart, St. G.—*The Cat*, pp. 56-58, figs. 28, 29 (London, 1881).
[2] Hilzheimer, M.—*Zool. Ann.* V, pp. 233-247 (1913).
[3] Pocock, R. I.—*Proc. Zool. Soc. London*, I, pp. 143-168 (1907).
[4] Max Weber, *Die Säugetiere*, II, p. 320 (1928).
[5] Hilzheimer, M.—*Geschichte unsere Haustiere*, p. 61 (Leipzig, 1912).
[6] Blyth, E.—*Journ. Asiat. Soc. Bengal*, XXV, pp. 442-445 (1856).
[7] Sclater, W. L.—*Cat. Mammalia Ind. Mus.*, II, p. 233 (Calcutta, 1891).

from *F. ocreata* either by the importation of tamed specimens or by reclaiming from the wild state of examples of this species which may have inhabited India in comparatively recent times".

The Harappa Cat appears to be the first representative of the Domestic Cat, the remains of which have so far been unearthed anywhere in India. I, therefore, following Hilzheimer and Pocock have adopted for it the name *Felis ocreata* Gmelin, race *domestica* Brisson.

Family : VIVERRIDÆ.

Sub-family : MUNGOTINÆ.

### **Mungos auropunctatus** (Hodgson).

The Small Indian Mongoose.

(Plate II, figs. 3-11.)

7783*a*. Mound F ; Great Granary area ; Square H 9/23 and I 9/3 ; depth 7′ 3″. "In a fragmentary cylindrical jar." Skull ; 2 almost complete lower jaws ; atlas and axis vertebræ ; right scapula ; right and left humerus ; right half of pelvic girdle, and right tibia.

Mound F ; Trench I ; Square M 10/15 ; depth 14′. Two almost complete lower jaws.

Sewell[1] recently recorded the find of a completely burnt skull of *Herpestes auropunctatus*[2] excavated at Mohenjo-daro, and it is of interest to find more complete and better preserved remains at Harappa.

The parietal and frontal regions and the jaws of the Harappa skull are broken, and the teeth are all missing, but there can be no doubt about its identification. The lower jaws are almost complete, but the incisor teeth are missing ; the dental formula i. $\frac{6}{6}$, c. $\frac{1-1}{1-1}$, p. $\frac{4-4}{4-4}$. m. $\frac{2-2}{2-2}$ is clearly indicated. The limb bones and the vertebræ are normal.

Figures of the skull and lower jaw are reproduced on Plate II. These may be compared with those published by Anderson[3] who also added comparative notes on the skull of this mongoose as compared with those of other species of the genus *Herpestes*.

*Distribution.*—According to Blanford, *M. auropunctatus* is widely distributed throughout Northern India being found in the lower Himalayas, from Sikkim to Kashmir, in the North-West Provinces, Punjab, Sind, Baluchistan, South Afghanistan and Southern Persia.

*Remarks.*—A point for consideration to which reference may be made here, is whether the Indian mongoose was not a sacred animal with the ancient Harappa people ; the occurrence of the mongoose bones in the burial jars seems to point in this direction. With the Buddhists[4] the Mongoose held in the right hand

[1] Sewell, R. B. S.—*Mohenjo-daro and the Indus Civilization*, II, p. 650, pl. clxiii, figs. 5. 7 (London, 1931).

[2] See Blanford, W. T.—*Faun. Brit. Ind., Mammalia*, p. 121 (1888) ; the generic name *Herpestes* as used by Blanford must be replaced by *Mungos*, see *Journ. Bombay Nat. Hist. Soc.* XXVI, p. 53 (1918).

[3] Anderson, J.—*Anatomical and Zoological Results comprising an account of the Zool. Res. of the two Expeditions to W. Yunnan*, p. 172, pl. ix, figs. 11, 12 (London, 1878).

[4] See Bhattacharya, B.—*The Indian Buddhist Iconography*, p. 114 (Oxford, 1924).

of Jambhala was supposed to be "the receptacle of all gems and jewels and when Jambhala presses the two sides of the mongoose it vomits forth the riches". In this connection reference may be made to Ichneumon—*Mungos ichneumon* (Linn.)—the Egyptian mongoose, the cult of which, according to Anderson and Winter[1] arose in "the Nome of Heracleopolis in Middle Egypt". The probable reason for its being revered was its supposed ability to tackle successfully the poisonous asp.

### Cynoidea.

#### Family : Canidæ.

In the identification of the skulls of the Canidæ a great deal of importance has rightly been attached to the measurements and the relative proportions of the cranial and facial areas. The earliest attempt in this connection was the classical memoir of Huxley[2]. Mivart[3] suggested certain modifications, but his measurements are not sufficiently comparative. Nehring[4] gave elaborate measurements of the skulls of various species of dogs, but his standards of measurements are far from satisfactory. Studer[5] proposed a standard set of measurements, and defined the exact points from which such measurements should be taken; these standards have been followed by Duerst[6] and with slight modifications by Hilzheimer[7]; in the following account I have adopted the same method. It is, however, necessary to explain that in the case of incomplete skulls, such as have been excavated at Harappa, it is not possible to take all the necessary measurements.

The measurements[8] that I have taken are as follows:—

1. Total length from Basion to Gnathion, corresponding to the Basilarlange of Studer.
2. Basicranial axis from Basion to the sphenoidal suture.
3. Basifacial axis from the sphenoidal suture to the inner edge of the first incisor.
4. Nasal length.
5. Maximum Nasal breadth.
6. Palatal length (after Huxley).
7. Maximum Palatal breadth between premolar 4 and molar 1.
8. Maximum width of the skull in the temporal region.
9. Width of the skull over the meatus auditorius externus.
10. Maximum Bizygomatic breadth.
11. Maximum Frontal breadth in the region of the postorbital process.

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[1] Anderson, J. and Winter, W. E. de—*Zoology of Egypt, Mammalia*, p. 192 (London, 1902). See also Hilzheimer, *Die Säugetiere* in *Brehms Tierleben* (4th edition), III, pp. 26-29 (Leipzig & Wien, 1915).

[2] Huxley, T. H.—*Proc. Zool. Soc. London*, pp. 232-288 (1880).

[3] Mivart, St. G.—*A Monograph of the Canidæ*, pp. 16, 17 (London, 1890).

[4] Nehring, A.—*Zool. Jahrb., Syst.*, III, p. 58 (1887).

[5] Studer, Th.—*Abhandl. Schweiz. paläontol. Ges.* XXVIII, pp. 2, 3 (1901).

[6] Duerst, J. U.—*Explorations in Turkestan*, II, pp. 346 *et seq.* (1908).

[7] Hilzheimer, M.—*Zoologica*, XX, Hft. 53, tables (1908).

[8] All the measurements of the teeth are of those of the upper jaw.

12. Minimum Frontal breadth between the inner borders of the orbits.
13. Cranial length from the upper margin of the Foramen Magnum to the Nasion or the origin of the Nasals (after Studer).
14. Facial length from Nasion to Gnathion (after Studer).
15. Maximum cranial height from Basion to Sagittal Crest.
16. Length of Canine.
17. Premolar 4 Length/Breadth.
18. Length of the two Molars.

## **Canis indicus** Hodgson.

The Indian Jackal.

(Plate II, figs. 12-15.)

Area G. A fragmentary skull with the left ramus of the lower jaw.

D. S. 29. (*D. R. S.* coll.) Left humerus without the head.

Blanford in the "Fauna of British India" Mammalia (p. 140) described the Indian Jackal under the name *Canis aureus* Linn., and considered it to be conspecific with the form that is found in "South-western Asia to the Caucasus, and....in South-eastern Europe in Greece and Turkey, and as far west as Dalmatia, also throughout Northern Africa" (p. 141). Wroughton[1] after comparison of the South Persian with the Indian Jackals concluded that the two are widely different, and proposed to drop the specific name *aureus* for the Indian Jackal and provisionally selected for it Hodgson's name *indicus*[2].

The characteristics of the jackal skull as defined by Blasius[3] and De Blainville[4] have been proved by Studer[5] to be of little value, while Huxley[6] had shown the great individual variability in the skulls of the Jackals in reference to the relative size of the teeth, the palatal length as compared to the length of the skull, the presence or absence of the sagittal crest, etc. Studer after a careful analysis of the Jackal's skull concluded that the cranial area of this animal is well arched; the frontal area flat, only slightly or not at all concave in the middle line; the profile of the frontal area runs almost in a straight line with the nasals and only in the region of the nose it is slightly depressed; the temporal area is less compressed than in the Wolf, and the snout is gradually pointed, only becoming a little narrowed along the canines. He further noted that the Cranial length of the Jackal's skull, as compared to that of all other Canidæ and particularly of the Wolf, is much greater than the Facial length.

The fragmentary skull (Plate II, fig. 12) excavated from the Area G, and in which the major part of the facial area, the zygomatic arches and the jaws are missing, is undoubtedly to be referred to the jackal. The lambdoidal crest is not greatly developed, the frontals are deeply arched and the area between them is

[1] Wroughton, R. C.—*Journ. Bombay Nat. Hist. Soc.*, XXI, pp. 837-839 (1912).

[2] Hodgson, B. H.—*Asiat. Res.*, XVIII, p. 237 (1833).

[3] Blasius, J. H.—*Naturgeschichte der Säugetiere Deutschlands*, p. 184 (Braunschweig, 1857).

[4] De Blainville, H. M. D.—*Ostéographie des Mammifères*, II, *Des Canis*, p. 22 (Paris, 1839-1864).

[5] Studer, Th.—*Abhandl. Schweiz. paläontol. Ges.*, XXVIII, pp. 16-19 (1901).

[6] Huxley, T. H.—*Proc. Zool. Soc., London*, p. 256 (1880).

broadly concave; the slightly curved triangular postorbital process points downwards. The brain-case in the parietal region is markedly swollen, and the maximum width of the skull is in the temporal region a little above the origin of the zygomatic arches. The lower jaw (Plate II, fig. 14) is only slightly arched, the coronoid process is broadly truncate and the condyle moderately broad and curved inwards in its inner half.

*Measurements (in millimetres).*

| — | Harappa skull. | I. Museum skull. | A. S. B. skull. |
|---|---|---|---|
| Total length | .. | 131 | 139 |
| Basicranial axis | 36 | 36 | 41 |
| Basifacial axis | .. | 92 | 100 |
| Nasal length | .. | 56 | 59 |
| Maximum Nasal breadth | .. | 13 | 16 |
| Palatal length | .. | 67 | 72 |
| Maximum Palatal breadth | .. | 42 | 40 |
| Maximum width | 50 | 54 | 50 |
| Width over Meatus auditorius externus | .. | 49 | 49 |
| Maximum Bizygomatic breadth | .. | 81 | 83 |
| Maximum Frontal breadth | 37 | 33 | 36 |
| Minimum Frontal breadth | 32 | 21 | 24 |
| Cranial length | .. | 79 | 86 |
| Facial length | .. | 72 | 72 |
| Maximum height | 40 | 41 | 42 |
| Length of Canine | .. | .. | 20 |
| Premolar 4— | | | |
| Length | .. | 17 | 16 |
| Breadth | .. | 9 | 7 |
| Length of the two Molars | .. | 20 | 20 |
| Length of Lower Jaw | 110 (incomplete.) | 110 | 117 |

The above measurements of the Harappa skull are unfortunately very incomplete, but for comparison I have given measurements of two skulls from the Indian Museum collection. Other measurements of the Indian Jackal's skull have been published by Huxley (*loc. cit.*, p. 277), and Wroughton (*loc. cit.*, p. 839), but owing to different standards having been employed by these authors it is not possible to compare their measurements with those tabulated above. The material at my disposal is not sufficient for a detailed analysis of the skulls of the Indian Jackal, but, as is indicated by the differences in the lengths of the basifacial axis and the cranial length, there appear to be two types in the samples before me.

The left humerus found at the site D. S. 29 agrees closely with that of a specimen in the Indian Museum.

*Distribution.*—According to Blanford (*loc. cit.*, pp. 140, 141) "the jackal is found throughout the whole of India and Ceylon, on hills and plains, in forest and open country, and even in populous cities. It ascends the Himalayas to an elevation of 3,000 or 4,000 feet....It is more rare east of the Bay of Bengal, but is found in Assam and Cachar, and is not uncommon at Akyab and about Thayetmyo in Northern Pegu".

### Canis pallipes Sykes.

The Indian Wolf.

(Plate III, figs. 1-5.)

10797(*d*) ? Skull without the premaxilla and a part of the maxillary bones on either side; fragments of right ramus of lower jaw; pelvic girdle fragments; sacral vertebræ; left calcaneum.

G. 289. Trench II; Square AN 42/21-22. Left femur; lumbar, sacral and caudal vertebræ.

Blanford in the "Fauna[1]" distinguished two Indian species of the wolf, *C. lupus* Linn. occurring in Baluchistan, western Sind and probably northern Punjab, and *C. pallipes* Sykes occurring in the Indian Peninsula south of the Himalayas. Mivart[2], however, considered *pallipes* to be only a variety of the Palæarctic *lupus*. Wroughton[3] in the "Results of the Mammal Survey of India" regarded *pallipes* as a distinct species and recorded it from Bhagad, and on the authority of the collector, C. A. Crump, noted that the wolf is common along the north coast of Cutch. The Harappa Wolf remains agree very closely with the skeletons of *C. pallipes* in the Indian Museum, and I have, therefore, no hesitation in identifying them with this species.

I give below the measurements of the Harappa skull and of two specimens from the Indian Museum collection. Photographs of the two are also published on Plate III (figs. 1, 2).

*Measurements (in millimetres).*

| — | Harappa skull. | I. M. specimens. | I. M. specimens. | From Studer. | From Studer. |
|---|---|---|---|---|---|
| Total length | .. | 195 | 193 | 195·5 | .. |
| Basicranial axis | 51 | 51 | 52 | 55 | .. |
| Basifacial axis | .. | 141 | 141 | 142 | 132 |
| Nasal length | .. | 82 | 90 | 82 | 61 |
| Maximum Nasal breadth | .. | 22 | 22 | 23 | 18 |
| Palatal length | .. | 114 | 113 | 112 | 95 |

[1] Blanford, W. T.—*Faun. Brit. Ind., Mammalia*, pp. 136, 137 (1888).

[2] Mivart, St. G.—*A Monograph of the Canidæ*, pp. 8, 9 (London, 1890).

[3] Wroughton, R. C.—*Journ. Bombay Nat. Hist. Soc.*, XXI, p. 837 (1912).

*Measurements (in millimetres)*

| — | Harappa skull. | I. M. specimens. | I. M. specimens. | From Studer. | From Studer. |
|---|---|---|---|---|---|
| Maximum Palatal breadth | 50 | 54 | 55 | 53 | 46 |
| Maximum width | 59 | 62 | 63 | 57·5 | 59 |
| Width over Meatus auditorius externus | 65 | 65 | 67 | 75 | .. |
| Maximum Bizygomatic breadth | 98 | 116 | 112 | .. | .. |
| Maximum Frontal breadth | 52 | 59 | 51 | 62 | 53 |
| Minimum Frontal breadth | 37 | 39 | 36 | .. | .. |
| Cranial length | 110 | 113 | 111 | 101·5 | 93 |
| Facial length | .. | 116 | 116 | 113 | 96 |
| Maximum height | 56 | 57 | 58 | 59 | 50 |
| Length of Canine | .. | .. | 26 | 21 | 20 |
| Premolar 4— Length | 20 | 21 | 22 | .. | .. |
| Breadth | 11 | 11 | 12 | .. | .. |
| Length of the two Molars | 22 | 21 | 22 | 20 | 18 |

All the skulls show a moderately to even strongly developed sagittal suture and an elongated facial area; the facial length in all cases exceeds the cranial length. The canine is longer than the combined length of the two molars.

The femur is 202 mm. long, and the other bones excavated at Harappa do not call for any remarks. I figure the fragmentary lower jaw, the femur and the calcaneum (Plate III, figs. 3-5).

## **Canis tenggeranus** Kohlbrugge, race **harappensis**, nov.

(Plate III, figs. 6, 7.)

AB Mound, trench, square and depth not indicated. One complete skull, one skull badly compressed, and a lower jaw fragment.

1781. An incomplete skull.

Area G. Facial part of a skull.

Unfortunately the labels with all these skulls do not indicate either the exact localities or the depths at which they were excavated; the only details on the labels are in reference to the sites, but these do not afford any clue either to their age or the associations in which they were found.

One of the skulls from the AB site is in a very good state of preservation and on Plate III, I reproduce photographs showing its lateral, ventral and dorsal views (figs. 6, 6*a*, 6*b*); for comparison the same views of the skull of an Indian Pariah in the Indian Museum are also reproduced (Plate III, figs. 8, 8*a*, 8*b*). These photographs show distinctly that the Harappa Dog is distinct from either *Canis matris optimæ* Jeitteles or *Canis intermedius* Woldrich, good photographs of which have been published by Antonius[1]. The skull indicates that the dog was of a moderately large size, with the snout moderately elongated and somewhat

[1] Antonius, O.—*Grundzüge einer Stammesgeschichte der Haustiere*, pp. 111, 113 (Jena, 1922).

pointed. The cranium in the parietal region is moderately swollen, and the maximum breadth of the skull is in the temporal region above the origin of the zygomatic arches; it is not so sharply compressed as in the case of the Indian Pariah. The forehead is distinctly depressed in the middle but not so much as in the Indian Pariah; the depression continues between the nasals; the region of the forehead is distinctly arched as in *C. pallipes*, and the arc continues without a break into the snout; in the Indian Pariah, on the other hand this axis is almost straight. The postorbital processes of the frontal are of moderate size, broadly triangular and curve downwards. The zygomatic arches are strongly developed but the maximum bizygomatic breadth is comparatively shorter than in the case of the Indian Pariah. The sagittal crest is feebly developed and is only seen as a low ridge running backwards from about the middle of the parietal region. The snout is not very narrow, and is only slightly constricted in front of the canines. The length of the canine is more than that of the two molars.

The lower jaw fragment, which I figure (Plate III, fig. 7) is similar to that of the Indian Pariah, only the coronoid process is not so truncate.

I give below a table of measurements, and for comparison have included measurements of two Pariah skulls in the Indian Museum collection and of two from Studer.

*Measurements (in millimetres).*

| — | Harappa. | Harappa. | Pariah skull. | Pariah skull. | Indian Pariah. After Studer. | |
|---|---|---|---|---|---|---|
| Total length | 150 | .. | ca. 140 | 145 | 156 | 160 |
| Basicranial axis | 45 | 47 | .. | 42 | 42 | 45 |
| Basifacial axis | 113 | .. | 98 | 113 | 114 | 115 |
| Nasal length | 75 | .. | 58 | 62 | 58 | 60 |
| Maximum Nasal breadth | ca. 17 | .. | 20 | 15 | 17 | 17 |
| Palatal length | 81 | .. | 72 | 76 | 89·5 | 86 |
| Maximum Palatal breadth | 46 | 47 | 44 | 45 | 44 | 44 |
| Maximum width | 50 | 52 | 55 | 51 | 56 | 55 |
| Width over Meatus auditorius externus | 53 | 53 | .. | 50 | 51 | 52 |
| Maximum Bizygomatic breadth | 86 | .. | 91 | 87 | .. | .. |
| Maximum Frontal breadth | 48 | .. | 46 | 41 | .. | .. |
| Minimum Frontal breadth | 35 | .. | 32 | 27 | .. | .. |
| Cranial length | 93 | 99 | ca. 83 | 86 | 90 | 91 |
| Facial length | 93 | .. | 76 | 76 | 85 | 89 |
| Maximum height | 51 | 53 | .. | 44 | 56·5 | 50 |
| Length of Canine | 21 | .. | ca. 20 | .. | .. | .. |
| Premolar 4— Length | 20 | 17 | 16 | 17 | .. | .. |
| Breadth | 10 | 9 | 13 | 8 | .. | .. |
| Length of the two Molars | 20 | 18 | ca. 19 | 18 | .. | .. |

For exact comparison I give below a table of indices[1] for *C. pallipes*. *C. indicus*, the Pariah, and the Harappa Dog :—

| — | Cranio-facial Index. | Zygomatico-Cranial Index. | Facial Index. | Fronto-Cranial Index. | Palatal Index. |
|---|---|---|---|---|---|
| *C. pallipes* | 103-105 | 54-56 | 100-104 | 81-95 | 47-49 |
| *C. indicus* | 84-91 | 60-62 | 87-89 | 65-72 | 56-63 |
| Pariah Dog | 88-92 | 59-61 | 84-87 | 80-83 | 59-61 |
| Harappa Dog | 100 | 58 | 108 | 80 | 56 |

As is clear from these indices the Indian Pariah shows distinct affinities with the Indian Jackal, while the skull of Harappa Dog appears to show a great deal of similarity with that of the Indian Wolf.

Darwin[2] after discussing in detail the views of earlier workers and the available evidence regarding the origin and descent of the Domestic Dog concluded that in view of the extreme antiquity of the various breeds and "the close similarity both in external structure and habits, between the domestic dogs of various countries and the wild species still inhabiting these same countries, the balance of evidence is strongly in favour of the multiple origin of our dogs". Mivart[3] discussed the views of Jeitteles[4], Woldrich[5], Nehring[6] and others, and was of the opinion that the evidence available would not justify the conclusion whether the origin of the dog was "single or multiple". Studer (*loc. cit.*, pp. 124-132) gave good reasons against Jeitteles' belief of the descent of the dog from the jackal, and concluded that the various races of the Domestic Dog have resulted from crossing between a Diluvial species of *Canis* and the wolf, both of which had the same range of distribution, through domestication and active selection by man. Later Studer[7] assumed a parallelism in development, and derived the Pariah dog direct from the Dingo, which he considered to have been distributed in former times all over Southern Asia; according to him it occurred in most recent times in the Tengger mountains of Java. His Diluvial species of *Canis* was discovered by him in the Palæolithic dog of Russia which he described under the name *C. poutiatini*. Hilzheimer[8] as a result of his careful researches on the North African jackals and the Domestic Dogs came to the conclusion that Studer's views in reference to the jackal as an ancestor of the dog were not justified, and

[1] The indices were calculated with the help of C. M. Furst's *Index-Tabellen zum Anthropometrischen gebrauche* (Jena, 1902) and are respectively $\frac{\text{Facial Length} \times 100}{\text{Cranial length}}$, $\frac{\text{Width of skull} \times 100}{\text{Maximum bizygomatic breadth}}$, $\frac{\text{Facial length} \times 100}{\text{Max. bizyg. breadth}}$, $\frac{\text{Max. Frontal breadth} \times 100}{\text{Maximum width}}$ and $\frac{\text{Palatal breadth} \times 100}{\text{Palatal length}}$.

[2] Darwin, C.—*The Variation of Animals and Plants under Domestication*, I, pp. 15-33 (London, 1868).

[3] Mivart, St. G.—*A Monograph of the Canidæ*, pp. 167-172 (London, 1890).

[4] Jeitteles, L. H.—*Die Stammväter unserer Hunde-Rassen* (Wien, 1877). See also the same author's paper in *Mitteil. anthropol. Ges. Wien*. II, pp. 56-80 (1872).

[5] Woldrich, J. N.—*Anz. kais. Akad. Wiss.* XXXII, pp. 12-16 (1886).

[6] Nehring, A.—*Zool. Jahrb., Syst.*, III, pp. 51-58 (1887). See also Pelzeln, A. von—*Zool. Jahrb.*, I, pp. 225-240 (1886).

[7] Studer, Th.—*Zool. Anz.*, XXIX (i), pp. 27-30 (1906).

[8] Hilzheimer, M.—*Zoologica*, XX, Hft. 53, pp. 82-105 (1908).

that several of the species of the sub-genus *Thos* Oken—the Jackals—had been domesticated and became the ancestors of the North African dogs. He was not able to bring forward conclusive evidence in reference to the intermixture of foreign types but described a form, *C. pallipes domesticus*, which undoubtedly appeared to him to be a descendant of the Indian Wolf—*C. pallipes* Sykes.

One important result of Studer's work, however, as Max Weber[1] has pointed out was that the old view of the descent of domesticated dogs of different countries from the wild dogs of those lands was given up, and more attention was concentrated in discovering the primitive Domestic Dog. This ancestral form, according to Max Weber's careful summary of the recent work, was characterised by its medium size, outwardly directed ears, hanging but not a bushy tail and a medium-sized but not greatly reduced snout. Such a form is represented amongst the recent types by the Australian Dingo, *Canis dingo* Blumenbach, and its other allies are the Javanese Barn-dogs and the Oriental Pariahs. The next prehistoric type, according to Antonius[2], was the Diluvial dog of the Russian Neolithic times, and which he designates—*C. poutiatini* Studer, but Brinkmann[3] is inclined to consider the species from the Northern Azylian as an earlier form. Next in the series come the dog of the Lake-dwellers—*C. palustris* Rütimeyer, the dog of the Bronze Age—*C. intermedius* Woldrich, and finally—*C. matris optimæ* Jeitteles from which the various domesticated races of the Shepherd-dog are believed to have been evolved. All the three forms mentioned above can be traced back to *C. poutiatini*, without any mixture with other ancestral types. The greyhound probably originated from the Pariah dogs as a result of domestication and selection alone and without any crossing with the other ancestral types, though a certain amount of admixture with the jackal is indicated. According to the recent work of Brinkmann the ancestor of the Domestic Dog was a medium-sized wolf of South-eastern Europe; this brings his views very close to those of Studer who considered the ancestral form to be the extinct—*C. ferus*, this, however, did not become extinct, but as a result of domestication and selection was transformed into *C. poutiatini*.

In view of the close affinity of the Harappa Dog with the Indian Pariah it would be useful to include here a short note about the Pariah. As has been discussed above, the Pariah, according to most authorities, represents with the Australian Dingo and the Javanese Barn-dogs, the ancestral type of the primitive Domestic Dog, but it is not conspecific with the Dingo, as Sewell[4] surmised. Jeitteles[5] a careful summary of whose work in reference to the origin of the Indian Pariah was published by Blanford[6], was inclined to the belief that there are two races of the Pariah, the larger probably derived from *Canis pallipes*—Indian

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[1] Weber, Max.—*Die Säugetiere*, II, pp. 326, 327 (Jena, 1928).

[2] Antonius, O.—*Grundzüge einer Stammegeschichte der Haustiere*. (Jena, 1922.)

[3] Brinkmann, A.—*Canidenstudien* V. VI. *Bergens Mus. Aarb.* (1923-24). Unfortunately the last two works are not available in Calcutta, and I have had to rely on Max Weber's summary of their conclusions.

[4] Sewell, R. B. S.—*Mohenjo-daro and the Indus Civilization*, II, p. 652 (1931).

[5] Jeitteles, L. H.—*Die Stammväter unserer Hunde-Rassen*, pp. 1-68 (Wien, 1877).

[6] Blanford, W. T.—*Proc. Asiat. Soc. Bengal*, pp. 114-117 (1877).

Wolf, and a smaller from the Indian Jackal—*Canis aureus* (=*C. indicus*), but Blanford remarked that he was unable to recognise two distinct races of Indian Pariahs. Pelzeln (*loc. cit.*) derived the "Indisch-ozeanischen Hunde," in which category the Pariah has to be included, from the Indian Wolf—*C. pallipes.* Studer (*loc. cit.*, p. 129) believed the ancestral form of the southern races of the dog to be *C. tenggeranus* Kohlbrugge, which survived in the Tengger Mountains of East Java up to comparatively recent times. This type had a wide distribution in the Oriental Region in the Diluvial times, and must have migrated with the early aborigines to Australia as the only Eutherian (*sensu* Huxley) or placental mammal before the Pleistocene times; in Australia this form was transformed into the true Dingo—*C. dingo* Blum. The ancestral form, *C. tenggeranus*, according to Studer, was domesticated and from it were derived the Pariah, the greyhound and the Tibet Dog. Duerst[1] after discussing the view of Studer in reference to the derivation of the Shepherd-dog from the Palæolithic dog of Russia, *C. poutiatini* Studer, suggested that the Pariah, the Shepherd-dog and the Anau Dog may have descended from the Dingo, and he designated the Anau Dog as *C. familiaris matris optimæ* Jeitteles.

In the view of the historical resumé given above and the close affinity of the Harappa Dog as indicated by the form of its skull and the indices, I consider it as allied to *C. tenggeranus* Kohlbrugge and suggest for it the racial name *harappensis*, nov.

The skulls of the dog excavated at Harappa from the AB site are, to judge from the nature of the bones, much older than the other two skulls from the Area G. and No. 1781 respectively.

## Order: *RODENTIA.*

### SIMPLICIDENTATA.

### Family: MURIDÆ.

### Sub-family: GERBILLINÆ.

### **Tatera indica** (Hardwicke).

The Indian Gerbille or Antelope Rat.

(Plate I, figs. 10-13.)

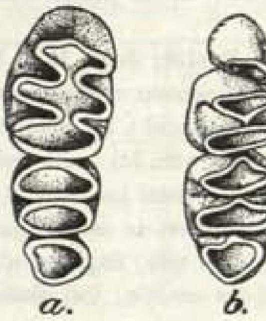
805. Mound AB; Extension of Pits I, II; Square P 24/17; depth 8′. A complete skull.
7849a. Mound F; Trench III; Square N 9/15; depth 10′ 3″; "from a very fragmentary jar". Right ramus of lower jaw and a right femur.

The large auditory bullæ and the dentition i. $\frac{2}{2}$, m. $\frac{3-3}{3-3}$ are sufficient for the identification of the bones referred to this species. The upper incisors show

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[1] Duerst, J. U.—*Explorations in Turkestan* II, p. 350 (1908).

the longitudinal grooves, the anterior molar in both jaws is composed of three transverse elliptical to lozenge-shaped areas, the second of two and the third of one; the third upper molar shows a trace of the secondary ridge or heel on the left side. For comparison I reproduce photographs of the skull and lower jaw of the Harappa Specimen and of a specimen in the Indian Museum from Bareilly, U. P., (Plate I, figs. 10-13) and figure the upper and lower right molars (text-fig. 1).



a. b.

TEXT-FIG. 1. *Tatera indica* (Hardwicke). (*a*) Upper, and (*b*) lower right molars, ×6, of specimens excavated at Harappa. Nos. 805 and 7849*a* respectively.

*Distribution.*—According to Blanford[1] *T. indica* is found "throughout India and Ceylon in suitable localities, extending west into Baluchistan, but not east of the Bay of Bengal"

Sub-family: MURINÆ.

### Rattus rattus (Linn.).

The Common Indian Rat.

7095*b*. Mound AB; Extension of Pits I, II; Square Q 24/5; depth 6′ 9″ "Found within a trough No. 7095 within pointed *lotas* and cylindrical vase." 2 femurs and 2 tibiæ with fragments of long bones.

7849*a*. Mound F; Trench III; Square N 9/15; depth 10′ 3″. Found in a "very fragmentary jar" Left ramus of lower jaw; sacral vertebræ; fragments of pelvic girdle, 3 femurs and 2 tibiæ.

The bones of the common rat found within jars in mounds AB and F agree with those of the common Indian Rat and I have no hesitation in referring them to this species.

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[1] Blanford, W. T.—*Faun. Brit. Ind., Mammalia*, p. 397 (1891); the generic name for this form is, however, *Tatera*, *vide* Wroughton, R. C.—*Journ. Bombay Nat. Hist. Soc.* XXV, p. 40 (1917).

## Order: *UNGULATA.*

### PERISSODACTYLA.

### Family: EQUIDÆ.

### **Equus asinus** Linnæus.

The Domestic Ass.

(Plate VII, figs. 7-11.)

Area G. A subrecent fragmentary skull, palatal portion with 4th premolar and molars 1-3 of both sides.

Mound F; Trench I; Square M 11/8; depth 10′. Right upper 4th premolar.

954. Square B/N; depth 16′. Fragment of skull consisting of maxilla with 4th premolar, and molars 1-3 of left side, and a bit of palatal portion; occipital region of skull, a portion of right maxilla with 3rd molar and Jugal; 2 complete 3rd metacarpals right; 2 complete and 1 distal fragment of 3rd metacarpal lef.

D. S. 40. A(*e*). (*D. R. S.* coll.) "from an earthen jar". Fragments of frontal and squamosal bones of skull, right side; fragment of lower jaw, right side—the coronoid process and a bit of the condyle; 2nd phalanx of right hind leg; 3rd premolar lower right.

D. S. 43. B. (*D. R. S.* coll.); 21′ below surface. 4th upper premolar right.

D. S. 29. (*D. R. S.* coll.). 2nd phalanx of right foreleg.

Gray[1] separated the domestic ass from the horse—*Equus*—in the sub-genus *Asinus*, and Lyddekker and other authors followed him in accepting this sub-genus. Later Lyddekker[2] in view of the difficulty in assigning the Kiang to either of the sub-genera *Equus* or *Asinus* concluded that the separation of the asses from the horse in the sub-genus *Asinus* "seems no longer logical," but in the Catalogue of Ungulates[3] he again separated the Ass as *Asinus*.

The dentition of *E. asinus* was described in detail by Owen[4] and he published good figures of the teeth of the upper and lower jaws. The question was also discussed in detail by Rütimeyer[5], who in addition to describing the teeth of the Ass discussed the differences as compared with those of the horse. Other literature on the subject is fully summarised by Duerst (*loc. cit.*, pp. 404-408). Unfortunately the Harappa remains are much too fragmentary and it is not possible, therefore, to analyse them on the lines of Rütimeyer's and Duerst's observations, but there can be no doubt that these remains are those of the common Indian Ass.

In reference to the ancestory of the Domestic Ass, most authorities agree that this animal was domesticated at a very early date; Antonius'[6] summary of the earlier literature may be consulted in this connection. Max Weber (*loc. cit.*, p. 656) and other authors consider *Equus asinus africanus* Fitzinger[7] of North-

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[1] Gray, J. E.—*Zool. Journ.* I, p. 244 (1925).

[2] Lyddekker, R.—*Novitat. Zool.*, XI, p. 584 (1904).

[3] Lyddekker, R.—*Cat. Ungulate Mam. Brit. Mus.* V, p. 36 (1916).

[4] Owen, R.—*Phil. Trans. Roy. Soc. London*, CLIX, p. 541, pl. lviii, figs. 1, 2 (1869).

[5] Rütimeyer, L.—*Abhandl. Schweiz. palaontol. Ges.* II, p. 10 (1875).

[6] Antonius, O.—*Grundzüge einer Stammesgeschichte der Haustiere*, pp. 266-273 (Jena, 1922).

[7] Fitzinger, M.—*Naturgee. Saugethiere*, III, p. 667 (1857).

east Africa as the ancestral type of the Domestic Ass, but Pocock[1] suggested that the Nubian wild ass probably formed the main ancestral stock of the domestic ass "with perhaps an infusion of *africanus* or *tæniopus* blood."

As has been remarked above the Harappa remains are very fragmentary. In none of the skulls the cranial or the complete facial parts are preserved and the limb-bones available are also very incomplete for a detailed account. The only portion of the skeleton that can be studied in some detail consists of the teeth (Plate VII, fig. 7) and for these I give below a table of measurements :—

*Measurements (in millimetres) of upper jaw teeth*[2].

| | 954 B/N Harappa. | *D. R. S.* coll. Harappa. | Mound F Harappa. | Sub-recent Harappa. | Indian Museum skull. |
|---|---|---|---|---|---|
| Premolar 4— | | | | | |
| Length of crown | 23 | 24 | 21 | 18 | 22 |
| Width of crown | 22 | 23 | 20 | 21 | 23 |
| Length of protocone | 11 | 12 | 10 | 9 | 8 |
| Length from posterior margin of crown to antecrochet | 12 | 14 | 11 | 11 | 11 |
| Length from posterior margin of crown to anterior lobe of protocone. | 20 | 20 | 17 | 13 | 17 |
| Molar 1— | | | | | |
| Length of crown | 20 | .. | .. | 13 | 19 |
| Width of crown | 23 | .. | .. | 20 | 20 |
| Length of protocone | 9 | .. | .. | 7 | 8 |
| Length from posterior margin of crown to antecrochet | 12 | .. | .. | 9 | 10 |
| Length from posterior margin of crown to anterior lobe of protocone. | 17 | .. | .. | 12 | 14 |
| Molar 2— | | | | | |
| Length of crown | 21 | .. | .. | 16 | 18 |
| Width of crown | 21 | .. | .. | 20 | 20 |
| Length of protocone | 10 | .. | .. | 7 | 7 |
| Length from posterior margin of crown to antecrochet | 12 | .. | .. | 9 | 10 |
| Length from posterior margin of crown to anterior lobe of protocone. | 16 | .. | .. | 13 | 13 |
| Molar 3— | | | | | |
| Length of crown | 19 | .. | .. | 22 | 20 |
| Width of crown | 17 | .. | .. | 18 | 16 |
| Length of protocone | 7 | .. | .. | 10 | 7 |
| Length from posterior margin of crown to antecrochet | 12 | .. | .. | 18 | 10 |
| Length from posterior margin of crown to anterior lobe of protocone. | 15 | .. | .. | 22 | 16 |

[1] Pocock, R. I.—*Ann. Mag. Nat. Hist.* (Ser. 8) IV, p. 526 (1909).

[2] The measurements given above are taken on the same lines as those by Duerst (*loc. cit.*, p. 387), but the lates terminology for the description of teeth as suggested by Osborn—*Evolution of Mammalian teeth* (New York, 1907) has been used in the above table.

The above measurements compare very well with those of the Ass published by Tscherski[1] except those of the 3rd molar which differ widely with the condition of wearing of the crown.

The indices of the projection of the anterior lobe of the protocone as suggested by Tscherski (*loc cit*, p. 300) in the case of the various upper teeth are as follows :—Pm. 4 : 155—166 ; M 1 : 133—141 ; M 2 : 130—144 ; M 3 : 122—125.

The metacarpals are 212-225 mm. in length with maximum diameters of 41-47 mm. and 45 mm. at their anterior and posterior ends (Plate VII, figs. 8, 9).

The two phalanges available apparently belong to two individuals of very different sizes, one is almost double of the other in maximum width. I reproduce natural size photographs of both the specimens (Plate VII, figs. 10, 11).

Family : Rhinocerotidæ.

**Rhinoceros unicornis** Linnæus.

(Plate VII, figs. 5, 6.)

Mound F ; Trench VI ; Square P 10/8 ; depth 8'7"-11'10". Fragments of right scapula.

Blanford writing in 1891 (*op. cit.*, p. 473) gave the distribution of *R. unicornis* in India as follows : " At the present day the great Indian rhinoceros is almost restricted to the Assam plain, and it is very rare, if it exists, west of the Teesta river. Twenty to thirty years ago it was still common in the Sikhim Terai, and not many years previously it was found along the base of the Himalayas in Nepal and as far west as Rohilcund. Up to about 1850, or rather later, some rhinoceroses inhabited the grass-jungles on the Ganges at the north end of the Rajmehal hills, and were, I think, probably *R. unifornis*. Formerly this animal was extensively distributed in the Indian Peninsula. It was common in the Punjab as far west as Peshawar in the time of the Emperor Baber (1505-1530). Semifossilized remains of it have been found in the Banda district, North-West Provinces, and near Madras ; and its co-existence with several mammals now extinct, the Indian hippopotamus for one, is shown by its occurrence in the Pleistocene beds of the Nerbudda Valley ". In reference to Babur's record of this species Beveridge in *Babur-nama*[2] describes the shooting of 3 rhinos in a bit of jungle near Bigram and also at Piag near Chunar. Abul Fazal[3] in *Ain-i-Akbari* described the rhinoceros and recorded its occurrence at Sambal (Sambhal), while Jarrett in a foot-note added, " In 1519 he (Babur) mentions having started many of these animals to the west of the Indus where none now exist ". Ali[4] in his paper on " Moghul Emperors of India as Naturalists " gives further references to the records of the rhinoceros in the writings or memoirs of the Moghul Emperors.

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[1] Tscherski, J.—*Mém. Acad. Imp. Sci. St. Petersburg* (Ser. 7) XL, pp. 360-363 (1893).

[2] Beveridge, A. S.—*The Babur-nama in English*, II, pp. 451, 657 (London, 1912-21).

[3] Jarrett, H. S.—*The Ain-i-Akbari* (translated into English), II, p. 281 (Calcutta, 1891).

[4] Ali, Salim A.—*Journ. Bombay Nat. Hist. Soc.*, XXXI, pp. 851-861 (1927).

The find of an almost complete right shoulder girdle of rhinoceros at Harappa considered with the records detailed above indicates that the distribution of this species in the earlier times was much more extensive in the Punjab and that probably there were marshy forest areas in the neighbourhood of Harappa where the rhinoceros was found.

A photograph of the right scapula (fig. 5) which I have reconstructed by joining together three fragments, is reproduced on Plate VII, and for comparison with it one of a specimen (fig. 6) in the Indian Museum. As will be seen from these photographs there are no real differences between the two scapulæ. The prescapular fossa, as seen from above, forms a broad channel delimited by the spine on the one side and a ridge which runs upwards and backwards from the coracoid knob; this fossa is narrower than the postscapular fossa, along the outer margin of which the blade of the scapula curves upwards to the suprascapular border. The glenoid cavity is large, convex and evenly rounded. The coracoid is a broad, rounded, knob-like structure, situated slightly above and anterior to the glenoid cavity; it is continued backwards as a broad, somewhat thickened plate-like structure till the origin of the prescapular fossa. The spine arises as a low ridge about four inches from the glenoid cavity and then runs as a broad ridge; in its posterior half the upper part of the spine is reflected over the postscapular fossa as a triangular plate, the tip of which is thickened into a knob-like structure. The scapula closely agrees with the figure of that of *R. unicornis* figured by the Blainville (*Ostéographie*, III, *Rhinoceros*, Plate vi).

*Measurements* (*in millimetres*).

| — | Harappa specimen. | Indian Museum specimen. |
|---|---|---|
| Length | *ca.* 470 | 460 |
| Maximum width along the suprascapular border | *ca.* 250 | 240 |
| Width along the coracoid | 185 | 160 |
| Length of spine | 310 | 310 |
| Height of spine | 130 | 130 |

## ARTIODACTYLA.

### Pecora.

### Family: Bovidæ.

### Sub-family: Bovinæ.

Blanford (*Fauna*, p. 483) remarked "By many modern writers the animals here referred to the genus *Bos* have been distributed amongst several genera. The distinctions between the latter, however, are scarcely of generic rank".

He, however, classified the Indian representatives of the family into three sub-divisions, the taurines, the bisontines and the bubalines. Hodgson[1] earlier had considered the forms on osteological and other characters to be distinct, but Lyddekker[2] pointed out that several of the distinctions in the crania as elucidated by Hodgson are not of generic value; he still treated the various Indian fossils under distinct generic names. In his latest Catalogue[3], however, he considered these sub-divisions to be of subgeneric rank only. Max Weber (*op. cit.*, pp. 592, 593) separated the cattle in the genus *Bos* with four subgenera *Bos* s.s., *Bibos*, *Pœphagus* and *Bison*, from the buffaloes in the genus *Bubalus*. I follow Lyddekker in considering *Bubalus* to be a subgenus of *Bos*.

### **Bos indicus** Linnæus.

The Zebu or Domestic humped cattle of India.

(Plate IV, figs. 3-10, Plate V, figs. 1-6.)

Mound F; Great Granary area; Square I 9/10, 15, 20; depth 1′-3′6″. 1st phalanx of 3rd finger and caudal vertebra.

Mound F; Great Granary area; Square H 9 & I 9; depth 0-3′. Rib fragment; Scapula fragment; 1st phalanx of 3rd finger; two, 2nd phalanges of 3rd and 4th fingers; right calcaneum and caudal vertebra.

7737*b*. Mound F; Great Granary area; Square I 9/5; depth 3′4″. 1st phalanx of 4th finger, and 3rd phalanx of 3rd finger.

Mound F; Great Granary area; Square I 9/25; depth 3′-5′. 3rd-4th metacarpal distal end, and right astragalus.

Mound F; Great Granary area; Square J 9/5, 10, 15; depth 3′-5′. Two lower jaw incisors; fragmentary 1st and 2nd upper right molars; two 1st, 2nd phalanges of 3rd finger; 3rd-4th metatarsal left, distal end; two 1st, 2nd phalanges of 3rd toe; three caudal vertebræ.

7286. Mound F; Great Granary area; Square I 9/4; depth 3′6″. Fragments of 3rd-4th metacarpal and pelvic girdle, and 1st phalanx of 4th finger.

Mound F; Great Granary area; Square K 9/2; depth 3′6″. Sternal rib fragment; right navicular, and 2nd phalanx of 4th finger.

Mound F; Great Granary area; Square K 8/5; depth 3′8″. Fragment of a charred scapula; 2nd phalanx of 3rd finger, and 1st phalanx of 4th toe.

Mound F; Great Granary area; Square I 9/15, 20; depth 3′-4′6″. 3rd lower left molar; right astragalus.

1653. Mound F; Great Granary area; Square I 9/14; 4′. Fragment of distal end of humerus; 3rd-4th metatarsal; right astragalus and navicular.

Mound F; Great Granary area; Square K 9/1; depth 4′. 2nd lower left molar.

Mound F; Great Granary area; Square K 9/1; depth 4′. 3rd phalanx 4th toe, and caudal vertebra.

Mound F; Great Granary area; Square I 9/10, 20; depth 4′-7′. Rib fragment; three 1st and two 2nd phalanges of 3rd, 4th fingers, and left astragalus.

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[1] Hodgson, B. H.—*Journ. As. Soc. Bengal*, X(i), pp. 449-470 (1841).

[2] Lyddekker, R.—*Mem. Geol. Surv. Ind., Pal. Ind.* (Ser. X), I, pp. 88-140 (1878).

[3] Lyddekker, R.—*Cat. Ungulate Mam. Brit. Mus.*, I, pp. 11-12 (1913).

Mound F; Great Granary area; Square K 9/5; depth 5′. 3rd premolar right upper; 1st molar right upper; 2nd molars right and left upper; 3rd molar left upper; 1st, 2nd molars lower right left; several bits of molar teeth, upper and lower; distal end of humerus; navicular right; phalanges 1st and 3rd of fore-leg.

Mound F; Great Granary area; Square I 9/8; depth 5′3″. Left 3rd lower molar; rib and axis vertebra fragments; caudal vertebra; right humerus fragment; 3rd-4th metacarpal, distal end; right pelvic girdle fragment; astragalus right; 1st phalanx of 3rd toe.

3759. Mound F; Great Granary area; Square I 9/8; depth 5′3″. Horn fragment; 3rd lower right molar and a fragment; rib fragment; caudal vertebra; scapula and pelvic girdle fragments; head of femur; 3rd-4th metatarsal fragment; 3 specimens of right and left astragalus and right calcaneum.

331. Mound F; Great Granary area; Square M 11/15; depth 6′-8′. Incisor tooth.

3848. Mound F; Great Granary area; Square I 9/6; depth 6′9″. Proximal fragment of 3rd-4th right metacarpal.

Mound F; Great Granary area; Square I 9; depth 6′-9′. Fragmentary upper and lower molar teeth.

Mound F; Great Granary area; Square K 9/1-5; depth 6′-9′6″. Two right upper 2nd molars; 5 incisors; 6 caudal vertebræ; fragments of 3rd-4th metacarpal of a young animal; distal fragment of left femur; epiphysis of right tibia; several 1st, 2nd phalanges of 3rd, 4th fingers and toes.

7839*a*. Mound F; Great Granary area; Square I 9/3; depth 7′. "From trough No. 7839". Head of right humerus; proximal fragment of 3rd-4th metacarpal; 2nd phalanx of 3rd finger; left astragalus.

7783*a*. Mound F; Great Granary area; Square H 9/23; depth 7′3″. 3rd upper right premolar; three fragments of lower jaw with left 3rd premolar and 1st molar. right 1st-3rd molars and left 2nd, 3rd molars.

1817. Mound F; Great Granary area; Square I 9/18; depth 7′3″. Five fragments of horn cores; 1st upper right molar; fragment of left ramus of lower jaw; 3rd lower right molar; caudal vertebræ; two proximal fragments of 3rd-4th metacarpal; pelvic girdle fragment; femur fragment; several fragments of 3rd-4th metatarsals; right calcaneum.

Mound F; Great Granary area; Square J 7/10; depth 6′ 9″. Left lower 3rd molar; fragment of left scapula; left astragalus; 1st phalanx of 3rd toe.

Mound F; Great Granary area; Square J 9/5,10; depth 7′-10′. Left 3rd upper premolar; fragment of a thoracic vertebra; left scapular fragment; 3rd-4th metatarsal left, distal fragment; astragalus right; calcaneum right; 1st phalanx of 4th toe.

Mound F; Great Granary area; Square J 9/19; depth 8′. Two incisor teeth.

243. Mound F; Great Granary area; Square J 9/16; depth 10′. Two incisor teeth.

Mound F; Great Granary area; Square I 7/10; depth 9′10″. Right upper 3rd premolar and 1st molar; right upper 1st, 2nd premolars; distal fragment of 3rd-4th metatarsal.

7287. Mound F; Great Granary area; Square I 9/19; depth 10′. Dorsal spine of lumbar vertebra; fragment of left scapula.

3929. Mound F; Great Granary area; Square I 9/7; depth 10′2″. "Out of a jar." Most bones charred. 1st upper right molar; thoracic rib fragment; left scapula; three fragments of 3rd-4th metacarpals; fragment of pelvic girdle; 3rd-4th metatarsal, left almost complete, and distal fragment of right.

2752. Mound F; Great Granary area; Square I 9/19; depth 11′. Horn core, fragmentary; proximal fragment of 3rd-4th right metatarsal.

Mound F; Great Granary area; Square J 9/15; depth 11′9″. Incisor tooth; fragment of left scapula; fragment of right pelvic girdle; left calcaneum.

Mound F; Great Granary area; Square M 11/16, 17, 21, 22; depth 21′6″. Fragments of a thoracic rib and two vertebræ; proximal part of 3rd-4th left metacarpal; fragment of pelvic girdle; left femur head.

182 (3). Mound F; Trench I; Square M 12/12; depth 8″. Right astragalus.

3530b. Mound F; Trench I; Square M 11/16; depth 4′10″. Fragments of 3rd-4th metacarpal and 3rd phalanx of 4th finger.

287. Mound F; Trench I; Square M 11/15; depth 11′ 6″. Incisor tooth.

10212. Mound F; Trench I; Square M 12/9; depth 9′10″-10′6″ Fragments of occipital and frontal regions of the skull; four horn-cores with bits of frontal bones; rib fragments; fragment of right scapula; distal half of left humerus; two fragments of radio-ulna; two fragments of 3rd-4th metacarpals; wrist bones of right side; 1st-3rd phalanges of hind legs; two fragments of pelvic girdle; almost complete right femur; proximal half of right tibio-fibula; two 3rd-4th right metatarsals; astragalus, calcaneum and cuboid of right and left sides; fragments of hind leg phalanges.

Mound F; Trench I; Square M 11/7, 8; depth 14′-15′2″. Fragment of lower jaw; centrum of axis vertebra; three 1st phalanges of 3rd-4th fingers.

Mound F; Trench I; Square M 11/7, 8, 12, 13; depth 15′4″-17′6″. Vertebral fragments; right scapula fragmentary; head of fibula; calcaneum right; two 1st and one 2nd phalanx of hind leg.

Mound F; Trench I; Square M 11/8; depth 10′. Right upper 2nd, 3rd molars; 1st, 2nd lower molars; scapula fragment; humerus left, fragmentary; 2nd-3rd metacarpals left, fragmentary; femur fragment; 2nd-3rd metatarsal right of a young animal; one right and two specimens of left astragalus.

Mound F; Trench I; Square M 11/7, 8; depth 17′-18′. Two upper right 1st molars; 3rd lower left molar; 1st phalanx of 4th finger; 3rd-4th metatarsal fragment; left astragalus and calcaneum.

3924. Mound F; Trench I; Square M 11/23; depth 19′. "Out of a jar." Partially charred. Distal end of left radio-ulna; two fragments of 3rd-4th metatarsal.

2053. Mound F; Trench I; Square M 11/13; depth 21′. 1st phalanx of 4th finger.

Mound F; Trench I; Square M 11/17,22; depth 21′6″. Complete 3rd-4th metacarpal, left, a fragment of proximal end of right side.

Mound F; Trench I; Square M 11/22; depth 21′6″. 2 right horn cores, incomplete.

Mound F; Trench I; Square M 11/17, 22; depth 21′6″. Horn fragment; centrum of axis; 2 almost complete 2nd-3rd metacarpals, right, left; 2nd-3rd metatarsal left, distal fragment and another fragment; right astragalus.

2520. Mound F; Trench III, Square N 9/3; depth 1′8″. A caudal vertebra.

1969. Mound F; Trench III; Square N 9/7; depth 11′. Incisor tooth.

3920. Mound F; Trench III; Square N 9/4; depth 7′6″. "From a fragmentary jar No. 3920." 2nd phalanx of 4th finger; right and left astragalus (charred).

5630. Mound F; Trench III; Square N 10/1; depth 5′6″-8′. "Out of an enclosure." Rib fragments; head of right tibiofibula.

7849a. Mound F; Trench III; Square N 9/15; depth 10′3″. "From a very fragmentary jar." Distal end of left tibia.

Mound F; Trench IV; Square K 12/3; depth? 3 fragments of horn cores; right upper 2nd premolar; 2 rib fragments; 3rd-4th metacarpal, proximal and distal fragments; head of left femur; three fragments of tibia; 3rd-4th metatarsal; three specimens of astragalus, 2 right, 1 left, three 1st and 2nd phalanges.

10333a. Mound F; Trench IV; Square I 13/11; depth 5′3″. Fragments of frontal area of skull; 1st phalanx of 4th finger; 2nd phalanx 3rd finger; fragments of pelvic girdle.

1637c. & 2574. Mound F; Trench III, IV; Square N 9/9; depth 8′9″-17′11″. Incisor tooth; and right femur distal fragment.

10008a. Mound F; Trench V; Square Q 12/25; depth 9′. Right radio-ulna with carpal bones.

Mound F; Trench VI; Square P 9/4; depth 3′2″. "From the bottom of a large jar." Femur head; 1st phalanx of 3rd toe.

Mound F; Trench VI; Square P 10/8; depth 8′7″-11′10″. Right horn of a young, specimen; upper right 2nd molar; fragments of lumbar vertebræ; almost complete right humerus; fragment of 3rd-4th metacarpal, distal end; 1st, 2nd phalanges of 3rd, 4th fingers; tibia right distal end fragment; astragalus left; calcaneum right and left.

Mound AB; Extension of Pits I, II; Square H 9 & I 9; depth 2′-4′. Caudal vertebra; right tibia distal end fragment; left astragalus; 2nd phalanx of 3rd toe.

Mound AB; Extension of Pits I, II; Square Q 25/16; depth 3′-3′6″. "From the west of the enclosure." Fragments of left scapula; right and left humerus; left half of pelvic girdle; right and left tibia.

Mound AB; Extension of Pits I, II; Square P 24/18,23; depth 3′-6′. Fragments of carpal bones.

3733. Mound AB; Extension of Pits I, II; Square Q 24/9; depth 4′6″. Fragments of rib, humerus, and 2nd phalanx of 3rd finger.

Mound AB; Extension of Pits I, II; Square P 24/13, 18, 23; depth 6′-9′. Scapular fragments; 1st phalanx of 3rd finger.

Mound AB; Extension of Pits I, II; Square Q 24/3; depth 6′-9′. Incisor tooth.

3690. Mound AB; Extension of Pits I, II; Square P 24/23; depth 11′6″. "Out of a jar." Left calcaneum, badly charred.

Mound D; Trench I; Square Q 31; depth 0-3′. Fragment of upper premolar tooth; 3rd-4th metacarpal right, proximal fragment; 1st phalanx of 3rd toe.

Mound D; Trench I; Square Q 31/20; depth 0-4′6″. 3rd lower molar left.

Mound D; Trench I; Square Q 31; depth 6′-9′. 1st, 2nd left molars and incisors; caudal vertebra; 3rd-4th right metatarsal distal fragment.

Mound D; Trench I; Square Q 31/13; depth 10′6″. 1st phalanx of 4th finger.

H 231*b*. Cemetery H; Square R 33, 34/25, 21; depth 2'4". Fragments of cervical and lumbar vertebræ and thoracic ribs; right trapezium.

H 483. Cemetery H; Square S 34/6; depth S 3'8". "Exposed burials." Distal fragment of left humerus; proximal bit of left radio-ulna; head of right femur, and fragment of left fibula.

H 503. Cemetery H; Square S 34/1; depth 4'4". "Exposed burials". Fragments of horn; atlas, axis and fragmentary cervical and thoracic vertebræ; right cuneiform; two 1st and one 2nd phalanx of 3rd finger.

H/C. Deep digging, Cemetery site. Two horn fragments and fragmentary premolar and molar teeth of upper jaw; two fragments of right and left ramus of lower jaw; rib fragment; three fragments of scapula; almost complete right humerus, and two fragments; three fragmentary 3rd-4th metacarpals; fragmentary pelvic girdle; six fragments of femur and two of left tibia; 4 fragmentary 3rd-4th metatarsals; three specimens of astragalus, two right and one left; 2 incomplete specimens of left calcaneum; 1st, 2nd phalanges and 3rd toe.

D. S. 1. Trench AB. (*D. R. S.* coll.); "in the Eastern Series of Great Granary area". Upper molar tooth fragmentary; proximal fragment of right 3rd-4th metatarsal; astragalus, right and left; calcaneum, right and left; left navicular.

D. S. 16. PII-32; (*D. R. S.* coll.); depth 5'6". Scapular fragments.

D. S. 17. PII-123; (*D. R. S.* coll.); depth 9'6". Axis and rib fragments (of a young calf).

D. S. 18. PII-93; (*D. R. S.* coll.); depth 9'. Fragment of 3rd-4th metatarsal; 2nd phalanx of 4th toe.

D. S. 20. Ab-555. (*D. R. S.* coll.). Scapular fragment.

D. S. 21. Af-357. (*D. R. S.* coll.). Left astragalus; 1st and 2nd phalanges of 4th toe.

D. S. 22. PIV-136. (*D. R. S.* coll.). Fragments of axis and a thoracic vertebra; 1st phalanx of 3rd finger; fragment of femur.

D. S. 23. Af. 357. (*D. R. S.* coll.). Two caudal vertebræ; scapular fragment; 1st phalanx of 3rd finger.

D. S. 26. A(e) 376. (*D. R. S.* coll.). Fragmentary premolar and molar teeth; four caudal vertebræ; fragment of humerus; right astragalus.

D. S. 30. A(e). (*D. R. S.* coll.). Caudal vertebra; rib fragment; left calcaneum, incomplete.

D. S. 32. B; (*D. R. S.* coll.); depth 4'. Incisor tooth.

D. S. 34. (*D. R. S.* coll.). Incisor tooth.

D. S. 37. Ab; (*D. R. S.* coll.); depth 11'6". Left lower 3rd molar, incomplete.

D. S. 38. A(e) 85. (*D. R. S.* coll.). Fragment of skull; left upper 2nd molar; ulna fragment; 1st phalanx of 3rd finger; 3rd-4th metatarsal fragmentary; left astragalus.

D. S. 39. A(a) 192. (*D. R. S.* coll.). Fragment of upper jaw, right side, with 3 molars, and another fragment of palatal area; 2nd phalanx of 3rd finger; fragment of pelvic girdle; proximal bit of 3rd-4th metatarsal; left astragalus and left navicular. All the bones are of a young animal.

B 954. Square B/n; depth 16'. 3rd upper premolar and 1st, 2nd molars; humerus right, two specimens; three fragmentary 3rd-4th metacarpals and 3rd-4th metatarsals.

II 7. Horn fragment; caudal vertebra, and fragments of 3rd-4th metatarsal and phalanges.

Ab-419. Five fragments of upper molar teeth.

I 9/19, 24. Fragment of right scapula.

P IV 125. 3rd right lower molar: four rib fragments; left astragalus; 1st phalanx of 4th toe.

VI. 3. Fragment of horn core; fragment of a lumbar vertebra; 3 fragmentary 1st-3rd phalanges.

M 10/25. Caudal vertebra; fragment of right radius; distal portion of 3rd-4th left metatarsal.

11266(*g*). Olecranon process of right ulna.

K 9/25. 2nd upper right molar tooth.

Mound F; Trench VI; Square P 10/8; depth 8′7″-11′10.″ Fragment of lower jaw; left astragalus complete and a fragmentary right; 2nd phalanx of 3rd finger.

I 7/15. Astragalus, right and left; right calcaneum incomplete; 1st, 2nd phalanges of 3rd finger.

P 24/22. Left lower 3rd molar; two fragments of scapula; olecranon process of right ulna; proximal portion of 3rd-4th metacarpal; head of femur; and right calcaneum.

J 7/5. Caudal vertebra; thoracic rib fragment; two fragments of left scapula; distal portion of right humerus; two 1st and one 2nd phalanx of 3rd finger; right calcaneum incomplete.

11266. Area G. Fragment of right half of pelvic girdle; 1st phalanx of 4th toe.

I 7/15. Two 2nd upper right molar; lower jaw fragment with 3rd left molar; fragment of pelvis; left astragalus.

M II. 1st upper right and left molars; 3rd premolar and 1st molar, lower left; fragmentary upper molar teeth; caudal vertebra; vertebral and metatarsal fragments.

Great Granary Area. 1st right upper molar; 3rd left lower premolar and 3rd left molar; axis centrum; scapular fragment; proximal and distal portions of 3rd-4th right and left metacarpals; 3 fragmentary 1st phalanges; pelvic girdle fragment; two fragments of 3rd-4th metatarsal; left astragalus.

The cattle remains from Harappa are mainly fragmentary and it is not possible, therefore, to compare them in detail with those of other forms. It is clear, however, that the remains belong to two distinct types; (i) large, massive form, probably of the type of the long-horned, humped cattle (*vide infra*, pp. 42, 43), and (ii) a smaller form with short horns, which probably represents the humpless race.

Unfortunately no complete skull or horns of the long-horned variety are available, but the short-horned type is represented by two fragments (No. 10212) which when joined together form the complete frontal region of the skull with the horns. I reproduce a photograph of this specimen (Plate IV, fig. 3). From the structure of the horns it is certain that they belong to an adult and not a young animal. The horns are forwardly and outwardly and not backwardly directed, as is generally the case.

*Measurements (in millimetres).*

| — | M 11/22. | F IV ; K 12/3. | No. 10212. |
|---|---|---|---|
| Distance between the bases of the horn-cores . . | 142 | .. | .. |
| Distance between the tips of the horn-cores . . . | 410 | .. | .. |
| Length of the horn-core (along outer curve) . . | 185 | *ca.* 260 | 250 |
| Length of the horn-core (along inner curve) . . . | 155 | *ca.* 210 | 210 |
| Circumference of the horn-core at the base . . . | 155 | 195 | 188 |
| Diameter of the horn-core at the base . . . . . | 54 | 65 | 64 |

The upper molar teeth from Harappa resemble those from Mohenjo-daro figured by Sewell (*op. cit.*, pp. 656, 657), their measurements are also similar. Some of the molar teeth of the lower jaw are exceptionally well preserved and are of a comparatively large size. I figure (Plate IV, fig. 5) one of these specimens (No. 7783*a*). The measurements (in millimetres) of the teeth in this fragment are as follows :—

| — | M 1. | M 2. | M 3. |
|---|---|---|---|
| Length . . . . . . . . . . . | 24 | 28 | 42 |
| Breadth (maximum) . . . . . . . | 16 | 17 | 18 |

This fragment apparently belonged to the large long-horned, humped race, for the teeth, which I consider to be those of the short-horned, humpless race are comparatively much smaller. Their enamel foldings are similar to those of the long-horned race, and no special differences in structure can be made out.

I reproduce photographs of two somewhat incomplete atlas and axis vertebræ (Plate IV, figs. 6 7), which apparently are those of an animal of the long-horned race. Unfortunately no complete ones of the short-horned race are available for comparison.

Of the limb-bones I give below a table of measurements (in millimetres) of such specimens as are complete to some extent, and reproduce photographs (Plate IV, figs. 8-10, Plate V, figs. 1-6) for comparison with those from Anau and of other cattle published by Duerst (*loc. cit.*, pp. 366, 367).

| — | Length. | Proximal diameter. | Median diameter. | Distal diameter. |
|---|---|---|---|---|
| *Humerus—* | | | | |
| Large-horned race from Cemetery site H/C . . . . . | 365 | 130 | 70 | 118 |
| Large-horned race from Site F/VI . . . . . . | *ca.* 320 | *ca.* 140 | 67 | 128 |
| Small-horned race from Mound AB . . . . . . | *ca.* 320 | .. | 56 | 97 |
| H483. Small-horned race from Cemetery H. . . . . . | *ca.* 280 | .. | 50 | 90 |

| — | Length. | Proximal diameter. | Median diameter. | Distal diameter. |
|---|---|---|---|---|
| *Radius-ulna*— | | | | |
| 10008*a*. Long-horned race from Mound F. | .. | .. | .. | 92 |
| Long-horned race from Mound F. | .. | .. | .. | 92 |
| H483. Long-horned race from Cemetery H. | .. | 88 | .. | .. |
| *3rd-4th metacarpal*— | | | | |
| Long-horned race from Site F VI | .. | .. | .. | 95 |
| Long-horned race from Site F IV | .. | 86 | .. | .. |
| Short-horned race from Cemetery Site H/C | 235 | 52 | 32 | 65 |
| *1st phalanx* (fore-leg)— | | | | |
| Long-horned race from F VI | 85 | 50 | 43 | 46 |
| 10212. Short-horned race from Mound F | 74 | 38 | 30 | 36 |
| *2nd phalanx* (fore-leg)— | | | | |
| Long-horned race from F VI | 60 | 46 | 41 | 43 |
| 10212. Short-horned race from Mound F | 53 | 36 | 30 | 33 |
| *Femur*— | | | | |
| 10212. Long-horned race from Mound F | 425 | *ca.* 135 | 50 | 120 |
| *Tibia*— | | | | |
| 5630. Long-horned race from Mound F | .. | 102 | .. | .. |
| Short-horned race from Mound AB | .. | 71 | 34 | .. |
| *3rd-4th metatarsal*— | | | | |
| 10212. Short-horned race from Mound F | 268 | 55 | 32 | 65 |
| *1st phalanx* (hind-leg)— | | | | |
| Long-horned race from Cemetery Site H/C | 73 | 40 | 33 | 35 |
| Short-horned race from Mound F | 65 | 32 | 29 | 31 |

The earlier naturalists divided the domestic cattle into two main divisions; the humped type or the Zebu of most European naturalists inhabiting the tropical countries and to which the name *Bos indicus* was given by Linnæus[1]; and the non-humped cattle for which he proposed the name *Bos taurus*. Geoffroy St. Hilaire[2], placing more reliance of philology than on the actual structural characters, opined that the European Cattle were imported from the East. Darwin[3] suggested that the "domestic cattle are almost certainly the descendants of more than one wild form", and he considered the humped and non-humped cattle to belong to distinct species. Rütimeyer[4] from a comparative study of the skeleton of *B. indicus*, *B. primigenius* Boj. and other forms, concluded that the Indian Zebu, as is clear from its skull, skeleton and general form, is a very

[1] Linnæus, C. von.—*Syst. Nat.* (ed. X), pp. 71, 72 (Holmiæ, 1758). Linnæus gives China as the provenance of *B. indicus*, but apparently this was intended for the whole of South-eastern Asia.

[2] Geoffroy St. Hilaire, I.—*Hist. Nat. Gén.*, III, pp. 82, 91 (Paris, 1854-62).

[3] Darwin, C.—*The Variation of Animals and Plants under Domestication*, II, pp. 79, 80 (London, 1868).

[4] Rütimeyer, L.—*Nouv. Mém. Soc. Helvét.*, XIX, pp. 149, 222 (1862).

distinct species, and that from very ancient times it has been almost the sole type of domestic cattle of Asia and Africa, and on that score alone has undergone much less structural modifications than the European forms. According to this author, *B. indicus* is in no way allied to *B. primigenius*, but its vertebral column and the limb bones show affinities with the Bison. Hodgson [1], who in his detailed account of the skeleton of the Indian Bovinæ divided them into four genera, *Bos*, *Bibos*, *Bison* and *Babulus*, considered the Gayal or Mithan, *B. frontalis* Lambert, as an "aberrant species leading to Bos". Blyth [2] proposed for the Zebu the name *Zebus gibbosus* and stated that the "humped cattle are unknown in an aboriginally wild state; and I am strongly of opinion that they will prove to be of African rather than Asiatic origin; however ancient their introduction into India". He further added that the fossil taurine of the Nerbudda deposits, *Bos namadicus* is "barely (if at all satisfactorily) distinguishable from the European *B. primogenius* (or true Urus of Cæsar)". Rütimeyer [3] considered *B. namadicus* Falconer from the Nerbudda Pliocene to be the oldest known Taurine, but was not sure whether it had descendants amongst the recent species. He further considered the European *B. primigenius* and the ancestral form of most domestic cattle, to be a parallel form of *B. namadicus*. In connection with the descent and relationships of *B. indious*, in his earlier work he expressed the opinion that it was closely allied to the Yak, *B. grunieris* Linn., and in his "Palæontological Reihe" placed the former as the tame form allied to latter wild one. In his later more detailed work he, however, modified his views to some extent. From his studies of the skulls of the Yak, *B. gruniens* and the Banteng, *B. sondaicus* he found a close affinity between these two forms, and concluded that the resemblance between the Yak and the Zebu is mainly superficial and not based on internal structure, while there appears to be some affinity between the Zebu and the Banteng.

Lyddekker [4] remarked that "there is no true taurine at the present time living anywhere in Asia, the aberrant *Bos indicus* being the only representative in India of the genus *Bos* as restricted by Hodgson and Gray". He described the differences between the skulls of the Nerbudda Ox, *Bos namadicus* Falconer and *B. primigenius*, and added that the cranium of the former approaches that of the genus *Bibos* to which he referred all the recent wild cattle of India.

Sclater [5] considered the Indian humped cattle to be only a race of the tamed European Cattle *Bos taurus*.

Blanford (*Fauna*, p. 483), who considered *B. indicus* to be specifically distinct from *B. taurus*, remarked that its origin "is unknown, but was in all probability tropical or subtropical, and was regarded by Blyth as probably African. No ancestral form has been discovered amongst Indian fossil bovines".

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[1] Hodgson, B. H.—*Journ. As. Soc. Bengal*, X, p. 469 (1841).

[2] Blyth, E.—*Journ. As. Soc. Bengal*, XXIX, pp. 284, 285 (1860).

[3] Rütimeyer, L.—*Verhandl. Naturfor. Gesel. Basel*, IV, pp. 346-354 (1865); and *Nouv. Mém. Soc. Helvét.* XXII, pp. 107-171 (1867).

[4] Lyddekker, R.—*Mem. Geol. Surv. Ind., Pal. Ind.* (Ser. X), I, pp. 89, 90, 96-112 (1878).

[5] Sclater, W. L.—*Cat. Mammalia Ind. Mus.*, II, p. 131 (1891).

Duerst's earlier memoirs [1] are unfortunately not available in Calcutta, but in his careful account of the Anau form (*loc. cit.*, pp. 359-369) he, as a result of his studies on the fossil remains of the bovines of Indian Pleistocene, concluded that *Bos namadicus* represents "the European Urus for the Asiatic Continent". He recorded from Anau remains of *B. namadicus* of which he considered *B. macroceros* Duerst to be a synonym (p. 359), and recorded further remains of the domestic cattle under the name *Bos taurus macroceros* (p. 364). This domestic race, according to Duerst (p. 369) had originated from the wild *B. namadicus*, and "is absolutely the same ox that was possessed by the ancient Egyptians". The earliest remains of this breed from Anau he considered to be as old as 8000 B. C. (p. 440), and added that according to the Chinese accounts this form reached India with tribal migrations about 3468 B. C. Its present-day distribution in India, according to this author (*vide* his pl. LXXXV) extends through almost the whole of the Indo-Gangetic plain and eastern half of Peninsular India.

The works of Arenader, Wilkins, Keller, Hahn, Laurer and Adametz on the ancestry and descent of the domestic cattle are unfortunately not available in Calcutta and for their views I have had to rely on Hilzheimer's careful summary [2]. After discussing the primitive groups, Brachyceros-group, Frontosus-group, Brachycephalous-group and Akeratos-group, suggested by various authors, Hilzheimer concludes "das der Ur allein der Stammavater sämtlicher Hausrinder ist". The Primigenius group is very closely allied to this ancestral type, and he believes that the Frontosus-, Brachyceros- and Brachycephalous- groups were evolved from it; the hornless or Akeratos-group, on the other hand, developed in various areas as a result of unfavourable surroundings, such as excessive heat or cold, from the horned cattle. He ascribed to the Urus a very wide range throughout Europe, Central and Western Asia and North Africa. In reference to the centre of their domestication he comes to no definite conclusions, but suggests that it may have been Europe or the whole of Eastern Asia (Ostasien); he does not agree with Hahn's view that they were first domesticated in Mesopotamia. He divides the cattle into two main groups:—1. Urrassen-Gruppe, and 2. Langstirnrassen; and considers the Asiatic Zebu to be closely allied to his subgroup "Steppenrassen" of the first group.

Antonius [3] considers the massive and very large horned *Bos planifrons* Rütimeyer of the Indian Pliocene as the oldest known ancestral form of the Cattle. With this form he considers *B. namadicus* Falconer of the same area to be closely allied, but adds that this species was smaller, had shorter horns and was a contemporary of man. The local races of this form spread further in Asia, but, except for the remains described by Duerst (*loc. cit.*) from Anau, Turkestan, these forms are known only from drawings, sketches or relief figures. Antonius believes these local races to be closely allied to the Urus—*B. primigenius*, the

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[1] Duerst, J. U.—*Die Rinder von Babylonien, Assyrien und Egyptien* (Berlin, 1899) and *Arch. Anthropol. Braunschweig*, XXX, pp. 233-294; 5 pls. (1904).

[2] Hilzheimer, M.—*Die Säugetiere* in *Bronns Tierleben* (4th edition), IV, pp. 334-347 (Leipzig & Wien, 1920).

[3] Antonius, O.—*Grundzüge einer Stammesgeschichte der Haustiere*, pp. 158-194 (Berlin, 1922).

widely distributed ancestral type of Europe and North Africa. The Urus existed for a long time in prehistoric times. In the earlier days it was captured by means of nets in Mesopotamia, but was later hunted by Assyrians, Syrians, Egyptians, Spaniards and the inhabitants of Central Europe; for a detailed account of these huntings reference may be made to Antonius (*loc. cit.*, pp. 160-163).

Nehring, Duerst and Hilzheimer derive the Brachyceros-stock of the domestic cattle of Europe from the Urus, but Rütimeyer considered it to be derived from the Indian Banteng. Antonius suggests for this stock a separate ancestor, closely allied to the Urus, and though he is not definite regarding the centre of its domestication, he believes that domestication must have taken place at the latest about 6000 B. C.

The Primigenius-stock he derives directly from the Urus, and suggests the northern Balkan States as the centre for its domestication.

The history of the Zebu-stock, according to the author, is very complicated and far from clear. Keller's view of its origin from the Banteng based on Rütimeyer's suggestion, cannot be accepted, as has been clearly proved by Ganz [1], and as Antonius was able to confirm from his own observations. He, therefore, suggests that the ancestral form of the Zebu (p. 186) was without doubt a local race of the Urus, probably some form such as *B. namadicus* Falconer of the Indian Pliocene. He discusses in detail the distribution of the Zebu-stock and is inclined to consider the red, straight-horned type of the Russian-Asiatic Steppes as a closely allied form which may either be a direct descendant or resulting from a cross with the Zebu-stock.

Max Weber (*loc. cit.*, p. 594) agrees in the main with Antonius, and derives the Zebu-stock from the Asiatic Urus. All the domestic races of Cattle of Asia and Africa, from the Central African Sanga to the dwarf cattle of Japan, are believed by Max Weber to be the direct descendants of this ancestral form.

Sir John Marshall [2] in his detailed account of Mohenjo-daro concludes from the representations of the cattle on seals and other objects that there were two breeds of Cattle in the Indus Valley; (i) the large-horned, humped cattle, engravings of which were found on seals 329-40, and which, according to the author, "was closely allied to, if not identical with, the magnificient white and grey breed still common in Sind, Northern Gujarat and Rajputana"; and (2) "a smaller, short-horned and humpless species which is not infrequently represented among the terra-cottas of this period".

The summary of the existing literature appertaining to the ancestry and descent of the Zebu-stock given above, though incomplete in some respects, leaves no doubt that the Pleistocene Indian *Bos namadicus* and its earlier progenitor *B. planifrons* Rütimeyer, have, with our present knowledge of the subject, to be accepted as the sole ancestral types of the cattle of the genus *Bos*. From these ancestral types the long-horned, humped cattle of Mohenjo-daro and Harappa, such as are found so well represented on the seals and other objects

[1] Ganz, H.—*Banteng und Zebu und ihrer gegenseitiges Verhältnis* (Halle, 1915).

[2] Marshall, Sir John.—*Mohenjo-daro and the Indus Civilization*, I, pp. 28, 29 (London, 1931).

unearthed at these places, must have been evolved and domesticated at a fairly early date by the people responsible for the early civilization of the Sind area. According to Sir John Marshall (*loc. cit.*, p. 106), "there appears to be no sufficient reasons for pushing back the *terminus a quo* of its antiquities earlier than 3250 B. C. At the same time it is evident—and I should like to stress this point once again—that the culture represented must have had a long antecedent history on the soil of India, taking us back to an age that at present can only be dimly surmised". This distinguished author also definitely states that the Indus people had domesticated the humped Zebu and the short-horned bull (Introduction, p. v). Such domestication and evolution must have taken a very long time and it would not be far wrong to surmise that it may have taken at least two to three thousand years to accomplish the domestication of the Cattle from their wild ancestors. This would make the date of domestication of the Indian Cattle contemporaneous with that of the European forms as suggested by Antonius (*supra*, p. 5). I am not inclined to agree with Duerst (*supra*, p. 41) that these Cattle reached India with tribal migrations about 3468 B. C., but believe in an autochthonous origin for the Indian Cattle in the Sind Valley.

The short-horned variety of the Sind Valley probably originated as a result of "decline of the cattle breeding" such as is suggested by Duerst (*loc. cit.*, p. 369) for a similar type of the Anau Cattle. In any case it is difficult to surmise for this race a migration from any outside centre.

## **Bos (Bubalus) bubalis** Linnaeus.

The Indian Domestic Buffalo.

(Plate V, figs. 7-9.)

Mound F; Great Granary area; Square K 8/5; depth 3′8″. 2nd phalanx of fourth toe.

Mound F; Great Granary area; Square I 9/15, 20; depth 3′-4′6″. Symphysis of lower jaw without teeth.

7773*a*. Mound F; Great Granary area; Square I 9/3; depth 6′6″. "From a very fragmentary round jar." Left calcaneum, fragmentary.

Mound F; Great Granary area; Square J 7/10; depth 6′9″. 1st molar upper right; left calcaneum; 1st phalanx of 4th toe.

1817. Mound F; Great Granary area; Square I 9/18; depth 7′3″. Right horn core, fragmentary.

Mound F; Great Granary area; Square I 7/10; depth 9′10″. 1st phalanx of 3rd toe.

Mound F; Trench I; Square M 11/8; depth 13′-13′6″. Left femur head.

Mound F; South end of Great Granary area; Square I 9/15; depth 7′4″. Right femur head.

10333*a*. Mound F; Trench IV; Square I 13/11; depth 5′3″. Distal fragment of 3rd-4th metacarpal; epiphyses of right tibia.

10008*a*. Mound F; Trench V; Square Q 12/25; depth 9′. Fragmentary upper jaw premolars; phalanges 1-3 of 3rd finger with fragment of cannon bone.

H 483. Cemetery H; Square S 34/6; depth 3′8″. Distal fragment of left radio-ulna.

H 503. Cemetery H; Square S 34/1; depth 4′4″. Right ramus of lower jaw with 3rd molar tooth, fragmentary.

Area G; Square II/27; depth ? 2 large fragments of skull, in one the palatal portion moderately well preserved.

Area G; Trench II; Square AM 40/21; depth 13′4″. Two fragments of right horn-core.

G 289. Area G; Trench II; Square AN 42/21, 22; depth ? Right femur distal half; right tibia proximal half.

5440*a*, *b*, *c*. Mound AB; Extension of Pits I, II; Square Q 24/10; depth 10′-10′6″. Left ramus of lower jaw.

F V/IV ? ? 1st molar, upper right, fragmentary.

H 39. ? ? Sacral vertebræ, fragmentary.

D. S. 27. Af. (*D. R. S.* coll.); 5′ below surface. Right 1st molar; right and left 1st premolar of upper jaw; caudal vertebra.

D. S. 43. B. (*D. R. S.* coll.); 21′ below surface. 1st right molar upper.

Unfortunately the cranial part in the only skull fragments available, is missing and it is, therefore, impossible to compare the skull of the Harappa form with that of the recent *B.* (*B.*) *bubalis*. The teeth available are also poorly preserved, and in most cases their grinding surfaces are badly worn or broken. I, however, give below measurements (in millimetres) of the upper jaw teeth and for comparison those of a recent specimen in the Indian Museum. A photograph of the skull fragments in which the palatal part is preserved, is reproduced on Plate V (fig. 7).

| — | Harappa specimen. | Indian Museum specimen. |
|---|---|---|
| Premolar 1— | | |
| Length | 17 | 21 |
| Maximum width | 14 | 20 |
| Premolar 2— | | |
| Length | 16 | .. |
| Maximum width | 15 | .. |
| Premolar 3— | | |
| Length | .. | 22 |
| Maximum width | .. | 21 |
| Molar 1— | | |
| Length | 21 | 30 |
| Maximum width | 24 | 27 |
| Molar 2— | | |
| Length | 27 | 35 |
| Maximum width | 24 | 30 |
| Molar 3— | | |
| Length | 33 | 34 |
| Maximum width | 25 | 26 |

The accessory columns are not strongly developed and the enamel plications resemble those of *Bos frontalis* figured by Duerst (*loc. cit.*, Plate LXXIV, fig. 9).

The lower jaw ramus is incomplete, but resembles in all respects that of a recent specimen in the Indian Museum. I figure this specimen on Plate V (fig. 9).

The horn-cores are all incomplete, and it is not possible to distinguish them, from their form and structure, from those of recent specimens. I figure one of the larger bits (Plate V, fig. 8).

None of the limb-bones available are complete and no measurements can, therefore, be taken for comparison. The available fragments, which I have carefully compared with those of recent specimens, show no special peculiarities.

From the very close structural resemblance between the skeletal remains excavated at Harappa and those of domestic buffaloes in the Indian Museum, I am inclined to consider the Harappa remains as those of the domesticated race of the buffalo such as is found in India at the present day

The Indian buffalo has rightly been regarded as the ancestor of the domesticated buffaloes by Rütimeyer[1], Hilzheimer[2] and other authorities. Rütimeyer in the work cited above considered *Hemibos triquetricornis* Falconer[3] from the Miocene beds of the Siwaliks as the ancestor of the Buffaloes (*s. l.*). From this form he derived the Indian *Arna* or the *Bos* (*B.*) *bubalis* Linn. through *Bubalus palæindicus* Falconer of the Pliocene Age. The African buffaloes, according to Rütimeyer, belong to a distinct stock which differs in the form of the occiput, in the choanæ being posteriorly placed, and in having semicylindrical horns. According to Lyddekker (*loc. cit.*, p. 90) the "living *Babulus arni* (=*B. babulis*) of India is without doubt the direct lineal descendant of the gigantic *Bubalus palæindicus* of the gravels of the Nerbudda and the topmost beds of the Siwaliks". In view of the discovery of stone implements with the remains of extinct buffalo in the valleys of the Godavéri and Nerbudda, he was of opinion that it was undoubtedly a "contemporary of man" Hilzheimer (*loc. cit.*, p. 312) believes that the Indian Buffalo, which at present is confined to the Oriental Region, had a much more extensive range in the west about the beginning of our era. This view, according to the author, is supported by the skeletal remains of the buffalo which have been found in some parts of Europe and its representations in the old Mesopotamian reliefs and in Egypt.

Duerst (*loc. cit.*, pp. 361, 362) considered the buffalo or "the other wild bull hunted by the ancient inhabitants of Persia, Babylonia and Assyria", as "*Babulus palæindicus* Falconer or the recent form descending from that Pleistocene species, *Bubalus arnee* Kerr" Its best representation according to Duerst, is found "on the cylinder seal of Sargon, King of Accad, who reigned

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[1] Rütimeyer, L.—*Verhandl. Naturfor. Gesel. Basel*, IV, pp. 329-334 (1865); also see his detailed work *Nouv. Mém. Soc. Helvét.* XXII, pp. 32-52 (1867).

[2] Hilzheimer, M.—*Die Säugetiere* in *Bronns Tierleben* (4th edition), IV, p. 313 (Leipzig & Wien, 1920).

[3] For description of the Indian fossil Ruminantia see Lyddekker, R.—*Mem. Geol. Surv. Ind., Pal. Ind.* (Ser. X) I, pp. 88-140 and 174-176 (1878).

B.C. 3800 to 3750 "[1]. A figure of this seal is reproduced by Antonius[2]. This author considers the Anoa of Celebes, *Bos depressicornis* (H. Smith), as the most primitive form, and believes it to be connected with *B. bubalis* through the Mindoro Buffalo of the Philippines, *Bos minoderensis* (Heude). According to him, no information is available either about the age or the centres of domestication of the buffalo, but it is probable that various local races of this animal were domesticated in different centres of its distribution.

*Distribution.*—The range of distribution of *B. bubalis*, which still survives in a feral state and has developed several local races as a domesticated or semi-domesticated animal, is, according to Sclater[3], " In low lands and swampy places, never in mountains; Assam and Ganges Valley including the Nepal Terai (Hodgson) and the Sunderbunds. In the peninsula of India from the Ganges southwards to the Godavery River (Jerdon) and westwards to the Weinagunga River and Mandla (Blanford); it is also found in the northern and eastern districts of Ceylon (Kelaart). It seems very doubtful whether the wild buffalo of Burma and Indo-China is truly feral or merely the escaped domestic animal ". Max Weber (*loc. cit.*, p. 593) considers *B. sondaicus* (Rütimeyer) of the Sunda Islands to be synonymous with *B. bubalis.* The Indian Buffalo has also been introduced into Egypt, Italy, Hungary and South Russia.

### Subfamily : CAPRINÆ.

The skeletal parts of sheep and goat are so closely similar that it is not an easy matter, particularly when fragmentary remains alone are available, to decide definitely whether they belong to the sheep or the goat. Rütimeyer[4], in his classifical work on the Fauna of the Swiss Lake-dwellings, gave useful characteristics for the identification of the remains of the two forms. According to him the hoof-phalanges and the surfaces of the body joints offer useful criteria for the identification of the two forms; the bones of the goat, further, show a slimness corresponding to those of the deer family. Cornevin and Lesbre[5] studied several domesticated races of sheep and goat in addition to the skeletons of various wild forms, and found characteristic differences in the skull, the vertebral column, particularly in the form of the axis, the apophyses of the dorsal vertebræ and in the numbers of the lumbar and caudal vertebræ, in the pelvic girdles, in the relative sizes of the metacarpals and metatarsals as compared to the lengths of the humerus and radius and the femur and tibia respectively, and in the shape of the phalanges. In this connection the following remarks of Kritz[6] are of special interest :—" Ganze Knochen (mit oberen und unteren Gelenken) lassen sich mit Sicherheit bestimmen, einzelne Zähne dagegen, sowie Fragmente von Kiefern gestatten nicht eine sichre Diagnose ; selbst die Bestim-

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[1] According to Cook, S. F.—*Cambridge Ancient History*, I, p. 156 (Cambridge, 1923), however, the date of the reign of Sargon of Agade is considered by various authorities to be somewhere between 2872-2500 B.C.

[2] Antonius, O.—*Grundzüge einer Stammesgeschichte der Haustiere*, p. 29 (Jena 1922).

[3] Sclater, W. L.—*Cat. Mammalia Ind. Mus.* II, pp. 129, 130 (1891).

[4] Rütimeyer, L.—*Nouv. Mém. Soc. Helvét.* XIX, pp. 124-129 (1862).

[5] Cornevin et Lesbre—*Bull. Soc. d'Anthropol. Lyons*, X, pp. 47-72 (1891).

[6] Kritz, M.—*Jahrb. K. K. Geol. Reichans.* XLI, p. 551 (1892). Also see Duerst, *loc. cit.*, p. 381.

mung der ganzer Kiefer (wenn nicht ganze Schädel vorliegen) ist schwankend ungeachtet der von Rütimeyer in seiner Fauna der Pfahlbauten, pp. 124-129, angeführten Unterscheidungsmerkmale".

The remains of these animals from Harappa are unfortunately very fragmentary. There is neither a single complete skull, nor a complete lower jaw. No complete limb-bones or girdles are available, and the identification of the remains available has, therefore, been a matter of some difficulty. I have carefully compared the material available with skeletons of goats and sheep in the Indian Museum, and even then some of the identifications must be doubtful.

## **Capra ægagrus** Gmelin, race **indicus**.

The Indian Domestic Goat.

(Plate VI, figs. 1-5.)

Mound F; Great Granary area; Square H 9 & I 9; depth 0-3′. 1st phalanges of 3rd and 4th toes.

Mound F; Great Granary area; Square J 9/5, 10, 15; depth 1′-3′6″. Left ramus of lower jaw fragmentary, and distal end of right tibia.

Mound F; Great Granary area; Square I 9/10, 15, 20; depth 1′-3′6″. Distal end of left 3rd-4th metatarsal.

Mound F; Great Granary area; Square K 9/2; depth 3′ 6″. 1st phalanges of 3rd finger; 3rd toe.

1817. Mound F; Great Granary area; Square I 9/18; depth 7′ 3″. Left ramus of lower jaw; fragments of radius and tibia (charred).

7846*a*. Mound F; Great Granary area; Square I 9/14; depth 8′. "From lower half of a fragmentary jar". Distal end of right 3rd-4th metacarpal.

Mound F; Great Granary area; Square J 9/19; depth 8′. Right calcaneum.

3687. Mound F; Great Granary area; Square J 7/20; depth 8′ 4″. Distal end of right 3rd-4th metatarsal.

3905. Mound F; Great Granary area; J 9/9; depth 9′ 8″. Fragments of femur and tibia; 3rd-4th metatarsal.

3929. Mound F; Great Granary area; Square I 9/7; depth 10′ 2″. Distal end of left 3rd-4th metacarpal.

Mound F; Trench I; Square M 11/7, 8, 12, 13; depth 15′ 4″-17′6″. Fragments of left radius; shaft of femur.

Mound F; Trench I; Square M 11/17, 22; depth 21′ 6″. Fragments of left ramus of lower jaw.

Mound F; Trench IV, Square K 12/3; depth ? Fragments of left humerus, radius and femur.

H307*b*. Cemetery H; Square S/34, 5, 10; depth 2′ 10″. Distal end of left humerus.

H502*f*. Cemetery H; Square S 34/1; depth 4′ 6″. Fragment of right maxilla with M 1-3; fragments of left humerus, radius and fibula.

184*b*. Cemetery H; Square S 34/6; depth 8′. Fragments of scapula and right tibia.

Mound D; Trench I; Square Q 31; depth 6′-9′. Right lower 1st molar; 2 fragments of a horn core.

Mound D; Trench I; Q 30; depth 6′-9′. Fragment of left scapula.

Mound AB; Extension of Pits I, II; Square P 24/13, 18, 23; depth 6'-9'. Distal ends of two specimens of right humerus.

H/C—Cemetery site—deep digging. Distal ends of two specimens of right humerus; left radius without epiphyses.

954. ? Square B/n., depth 16'. Palatal portion of skull with premolars 1-3, and molars 1-3.

D. S. 18. P II-93; (*D. R. S.* coll.); depth 9'. Horn core, incomplete.

D. S. 27. Af; (*D. R. S.* coll.); depth 5'. Upper right second molar.

H 507. Cemetery H; depth 3'10". Fragments of lower jaw and a sternal rib.

H 573. ? ? Incomplete right femur.

The few teeth available do not show any special peculiarities and generally resemble those of the recent domestic goats; I have also not been able to trace any differences between these teeth and the descriptions and figures of the molar tooth of goat by Cornevin and Lesbre (*op. cit.*, pp. 48-50, fig. 6). I figure the fragment of a lower jaw No. H 507 (Plate VI, fig. 1).

The horn cores are unfortunately all very fragmentary, but they resemble those of a goat figured by Duerst (*loc. cit.*, Plate lxxvi, fig. 14) and the inner cavity of the core is, as in the case of the Anau goat, very extensive. I reproduce a photograph of the specimen (No. D. S. 18) excavated from a depth of 9 feet at Harappa (Plate VI, fig. 5).

The metacarpal and metatarsal remains are all fragmentary, as are those of the humerus, radius, femur and tibia, and it is not possible, therefore, to give any comparative measurements. Photographs of some of these are reproduced on Plate VI (figs. 2-4).

The selection of a name for the Domestic Indian Goat is a matter of some difficulty. I agree with Blanford (*Fauna*, p. 503) that there "can be no doubt that *C. ægagrus* is one of the species, and probably the principal, from which tame goats are derived," but the adoption of the name *Capra hircus ægagrus* for *C. ægagrus*—the Persian Wild Goat as Blanford calls it—as Lyddekker[1] has done, implies that *C. ægagrus* is derived from *C. hircus* Linn.—the domesticated goat of Sweden. I, therefore, propose to designate the Harappa Goat, which I consider to be a domesticated form of *C. ægagrus* and with it all the Indian domestic goats as *C. ægagrus* race *indicus*.

The ancestry of *C. ægagrus* is still uncertain, as the only two forms so far described from the Indian Tertiaries by Lyddekker[2], *viz.*, *C. sivalensis* and *Capra* sp., are, according to the author, allied to *Hemitragus hylocrinus* (Ogilby) and *C. falconeri* (Hügel) respectively, and not to *C. ægagrus*.

Blanford's view in reference to the ancestry of the domestic goats has been noted above. Lyddekker[3] went a step further in considering *C. ægagrus* or *pasang*—the name given to the male of this species by the Persians— "the ancestral stock of all the numerous varieties of the domestic goat". Danford[4] had, however, some years earlier suggested that while *ægagrus* formed the

[1] Lyddekker, R.—*Cat. Ungulate Mam. Brit. Mus.*, I, pp. 156, 157 (London, 1913).

[2] Lyddekker, R.—*Mem. Geol. Survey Ind., Pal. Ind.* (Ser. X) I, pp. 169-171 (1878).

[3] Lyddekker, R.—*Horns and Hoofs*, p. 107 (London, 1893).

[4] Danford, C. G.—*Proc. Zool. Soc. London*, pp. 458-468 (1875).

principal stock, it cannot be considered as the only source from which the goats had sprung, and that probably the various forms of ibexes also contributed to the different types of goats. Antonius[1] is definitely against any connection between the Indian domestic goats and the Thar (*Hemitragus*), and, in view of the close similarity of the present day Indian forms to modern Egyptian goats, considers these short-horned forms to have a preponderance of *ægagrus* or *C. prisca* blood. Duerst (*loc. cit.*, p. 380), who called the Anau Goat—*Capra ægagrus rutimeyeri* Duerst, considered this form to be "a short-horned goat, such as lives still, in a slightly differentiated form, in Central, Eastern, and Southern Asia, as well as in the Malayan Archipelago". He further on (p. 441) considered the possibility, even the probability, of India and probably Persia being the "ancestral lands" from which the importations of the camel, the goat, and possibly the hornless sheep with the domestic pig and the shepherd-dog had taken place to Central Asia and Europe. Hilzheimer[2] remarks that as a result of recent work the origin of the Domestic Goat may be considered to be definitely solved. He believes the domestic types to be descended from the wild Goats of the genus *Capra*, and is of the opinion that genera like *Hemitragus* were in no way concerned with their origin. He divides the domestic types into two groups:—*Hircus*-group and the *Prisca*-group. The former group, according to the author, is mainly confined to North and Middle Europe, though some forms are also found in Southern Europe, but it does not extend to South and Central Asia. In the latter group he includes the Æthiopian Goat, various races of which are found in Arabia, Syria, North Africa and as far as Nepal; he also includes in this group the Kashmir form which supplies the supreme quality of wool for the Kashmir shawls. Max Weber (*loc. cit.*, p. 589) agrees in the main with Antonius in accepting three "Domestikationscentra", and considers *C. ægagrus* as the ancestor of the sable-horned goats. In view of the above and *C. prisca* being probably a descendant of *C. ægagrus*[3], I propose designating the Indian Domestic Goat as *C. ægagrus* race *indicus*.

### **Ovis vignei** Blyth, race **domesticus**.

The Harappa Domestic Sheep.

(Plate VI, figs. 6-13.)

H 501*f*. Cemetery H; Square S 34/1; depth 4′ 8″-5′ 3″. Incomplete and badly compressed skull.

Mound F; Great Granary area; Square K 9/2; depth 3′ 6″. Fragment of left humerus.

7851*a*. Mound F; Great Granary area; Square I 9/3; depth 3′ 10″. "From a very fragmentary jar No. 7851." Left horn core.

[1] Antonius, O.—*Grundzüge einer Stammesgeschichte der Haustiere*, pp. 226-231 (Jena, 1922).

[2] Hilzheimer, M.—*Die Saugetiere* in *Brehms Tierleben* (4th edition), IV, pp. 288-294 (Leipzig & Wien, 1920).

[3] In this connection see also Schwartz, E.—*Ann. Mag. Nat. Hist.* (Ser. 10) XVI, pp. 433-437 (1935), who concludes that "there cannot be any doubt that the majority of domestic goats, including "*C. prisca*" have been derived from the wild *C. a. ægagrus*". Earlier in his paper, he however considers *ægagrus* as a subspecies of *C. hircus* Linn.

Mound F; Great Granary area; Square K 9/5; depth 5′. Distal end of left 3rd-4th metatarsal.

3759. Mound F; Great Granary area; Square I 9/8; depth 5′ 3″. Fragment of left ramus of lower jaw with M. 2, 3.

Mound F; Great Granary area; Square I 9; depth 6′-9′. Two fragments of right tibia.

Mound F; Great Granary area; Square K 9/1-5; depth 6′-9′. Fragments of tibia, femur and 3rd-4th metatarsal; 1st phalanx of 3rd finger.

3905. Mound F; Great Granary area; Square J 9/9; depth 9′ 8″. Two left horn cores; distal part of left tibia.

4989*a*. Mound F; Great Granary area; Square K 8/3; depth 10′ 6″. Fragment of right ramus of lower jaw with Pm. 1, 2 and M. 1-3.

Mound F; Great Granary area; Square J 9/15; depth 11′ 9″. Fragment of tibia.

851(4). Mound F; Trench I; Square M 11/11; depth 12′. Distal end of radius.

7823*a*. Mound F; Trench III, Square N 10/1; depth 9′. Left calcaneum.

10008(*a*). Mound F; Trench V, Square 12/25; depth 9′. 1st and 2nd phalanges of 3rd and 4th fingers.

Mound F; Trench VI, Square P 9/4; depth 3′ 2″. "From the bottom of a large jar." Fragment of right ramus of lower jaw with Pm. 3, M. 1-3.

Mound F; Trench VI; Square O 9/19; depth 4′ 4″. "From an oval *ghara*." Head of left tibia.

Mound F; Trench VI; Square P 10/8; depth 8′ 7″-11′ 10″. Distal end of right humerus; proximal end of left radius; promixal end of 3rd-4th metacarpal; distal end of left tibia.

Mound D; Trench I; Square Q 31/20; depth 0-4′ 6″. Left astragalus and calcaneum.

4081. Mound D; Trench I, Square Q 31/19; depth 1′ 6″. Left 3rd lower incisor.

H 483. Cemetery H; Square S 34/6; depth 3′ 8″. Tibia fragments.

H 484*b*. Cemetery H; Square S 34/2; depth 5′ 10″. Lower jaw fragment; 1st molar upper right; fragments of humerus and tibia; right astragalus; left navicular & cuboid; 1st phalanx of 3rd finger.

H/C.—Cemetery site, deep digging. Two axis and one 3rd cervical vertebra.

Mound AB; Extension of Pits I, II; Square Q 24/18; depth 5′ 3″. 3rd lower molar right; 1st phalanx 3rd toe.

7174*e*. Mound AB; Extension of Pits I, II; Square Q 25/1; depth 9′. Fragment of left humerus.

954. Square B/n; depth 16′. Almost complete right tibia.

I 8/15. ? ? Distal end of right 3rd-4th metacarpal.

I 7/15. ? ? Left radius fragment; 3rd-4th metacarpal, proximal and distal ends; distal end of left femur.

I 8/25. ? ? Distal end of right tibia and fragment of 3rd-4th metatarsal.

S 39/1. ? ? ? Two 2nd upper molar teeth.

P II/83. ? ? Cervical vertebral fragment; fragments of right humerus, femur and pectoral girdle.

P 24/22. ? ? Right ramus of lower jaw, and distal end of right tibia.

3919. "Spoil earth." Fragment of horn core.

G 10212. ? ? Distal ends of left humerus and femur; proximal half of 3rd-4th metatarsal.

VI/3. ? ? 3rd-4th metacarpal fragment, and 1st phalanges of 3rd and 4th fingers.

Pit I, Rev. II. ? ? Left humerus, distal end; proximal part of right radius.

D. S. 18. P II-93; (*D. R. S.* coll.); depth 9'. Left 3rd lower molar; distal fragments of left and right humerus; fragment of pelvic girdle; right calcaneum.

D. S. 20. Ab-555. (*D. R. S.* coll.). ? ? Sternal rib fragment; left 3rd-4th metacarpal, proximal part.

D. S. 21. Af. 357. (*D. R. S.* coll.). ? ? Right 3rd-4th metacarpal fragment.

D. S. 27. Af; (*D. R. S.* coll.); depth 5'. Fragment of right 3rd-4th metacarpal.

My remarks in reference to the remains of the Goat from Harappa (*supra*, p. 48) are equally applicable to those of the sheep excavated in the same locality. The remains of the sheep, as the list given above indicates, are more numerous but they are almost without exception fragmentary. Not a single complete long bone or a skull is available, and it is difficult, therefore, to be certain about the sizes or to take measurements for comparison with those of other forms.

Two almost complete horn cores, No. 3905, were excavated from the Mound F at a depth of 9 feet 8 inches and I give below their measurements (in millimetres).

| | 1. | 2. |
|---|---|---|
| Length of the horn-core | 150 | 140 |
| Circumference at base | 95 | 92 |
| Circumference 20 mm. below the tip | 40 | 38 |
| Longitudinal diameter | 30 | 36 |
| Transverse diameter | 21 | 23 |

The horn cores in section would be somewhat ovoidal, more rounded outwardly and compressed to almost a point inwardly; they are greatly compressed from side to side inwardly. Photographs of two of the cores are reproduced on Plate VI (figs. 8, 9).

The only skull (Plate VI, fig. 6) available is in a poor condition. It is badly mutilated, but the posterior view (Plate VI, fig. 7) closely resembles the figure of the skull of a sheep published by Cornevin and Lesbre (*op. cit.*, p. 53, fig. 3). The teeth also, so far as I have been able to compare them with those of recent specimens, are similar.

The limb bones including the phalanges do not call for any special remarks. I, however, reproduce photographs of some of the better preserved remains on Plate VI (figs. 11-13).

The selection of a name for the Indian Domestic Sheep offers the same difficulties as the Indian Domestic Goat (*vide supra*, pp. 48, 49). Sewell (*loc. cit.*, p. 659) tried to get over the difficulty by designating the remains of the sheep from Mohenjo-daro as of *Ovis* sp. Blanford (*Fauna*, p. 494) after recording the occurrence of wild sheep in the Palæarctic and Nearctic regions, the range of one of which extends into Sind and the Punjab, remarked that "the origin of tame sheep is quite unknown". No fossils of sheep have been recorded so far from the Tertiaries of any part of India, and Lyddekker[1] does not commit himself to any definite views either in reference to its ancestry or the question of domestication. Antonius[2] after discussing the difficult question at great length

[1] Lyddekker, R.—*Hoofs and Horns*, pp. 57-89 (London, 1893).

[2] Antonius, O.—*Grundzüge einer Stammesgeschichte der Haustiere*, pp. 204-226 (Jena, 1922).

concludes that there were probably three centres of domestication for the sheep, and that the oldest and most important of the ancestral forms was the "vorderasiatische" form, which corresponds to the comparatively long-tailed, Trans-Caspian sheep with curved horns or its allied forms from Eastern Persia. Reference may be made to this work for a detailed review of the literature and for the other centres of domestication which are of no interest to us in connection with the Indian sheep. Duerst (*loc. cit.*, pp. 370, 380) recorded the remains of a wild sheep from Anau under the name *Ovis vignei arkal* Lyddekker, and of a domestic sheep, which he considered to be identical with the "turbary sheep" of the Swiss Lake-dwellings, and, therefore, designated as *Ovis aries palustris* Rütimeyer. Though he considered it possible that a tame turbary sheep "can have originated from a wild *Ovis vignei arkal*" he also suggested that the domestic sheep of Anau may be "an autochthonously derived domesticated form". Lyddekker[1] in his last work was of the opinion that "it is most probable that the mouflon (*O. musimon*) is one of the ancestral forms". This species of wild sheep is found in Sardinia, and though it is of importance in connection with the European varieties, it could not have any direct bearing on the domesticated varieties of the Indian Sheep. Hilzheimer[2] divides the Domestic Sheep into four main groups :—*vignei*-group, *orientalis*-group, *musimon*-group and the Argali-group. In the *vignei*-group he, with reservation, includes the hairy sheep which is distributed in Asia from north Arabia over Afghanistan to India; the Harappa form was probably one of this group of long-legged, long-tailed sheep. Max Weber (*loc. cit.*, p. 589) who summarises the earlier literature, noted that the various races of the Domestic Sheep, which are designated *O. aries* Linn., are the result of domestication over a long period both in Europe and Asia. After discussing the descendants of *O. ammon* Linn.—the Argali of the Altai Range, he considers the turbary sheep—*O. aries palustris* to have been derived from the Red Sheep of Asia Minor—*O. orientalis* Brandt & Ratzeburg. From this descended the European *O. musimon*, while the short-tailed North European Sheep is also believed to be a descendant from this stock. Finally the long-limbed and long-tailed sheep, which produce various grades of wool, are to be derived from the Asiatic *O. vignei*-stock.

With our present knowledge of the domestication of sheep it is impossible to be certain about the origin of the various races of Indian Sheep, but the possibility of the *O. vignei* ancestorship for the Harappa Sheep is indicated. The range of the Urial—*O. vignei* which, according to Blanford (*Fauna*, p. 408) "is found in the Punjab Salt Range and in places throughout the ranges west of the Indus in the Punjab and Sind down to the sea-level", was probably more extensive in the earlier times and it may be surmised that some form of it, which was found feral round Harappa, was domesticated by the Harappa people. For this reason I propose provisionally to designate the Harappa Sheep —*Ovis vignei* race *domesticus*.

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[1] Lyddekker, R.—*Cat. Ungulate Mam. Brit. Mus.*, I, p. 75 (London, 1913).

[2] Hilzheimer, M.—*Die Säugetiere* in *Brehms Tierleben* (4th edition), IV, pp. 257-268 (Leipzig & Wien, 1920).

Family : CERVIDÆ.

**Cervus (Recurvus) duvauceli** Cuvier.

The Barasingha.

(Plate IV, figs. 1, 2.)

H/C. Cemetery site, deep digging. Fragment of right antler.

350. Mound AB; Extension of Pits I, II; Square Q 24/2; depth 4′. Antler tip.

3733. Mound AB; Extension of Pits I, II; Square Q 24/9; depth 4′ 6″. Antler tip.

3380. Mound AB; Extension of Pits I, II; Square Q 24/12; depth 9′. Antler tip highly polished.

2220. Mound AB; Extension of Pits I, II; Square Q 24; depth 7′-9′ 6″. Antler tip.

1159. Mound AB; Extension of Pits I, II; Square P 24/12; depth 7′ 4″. Fragment of antler.

170. Mound F; Great Granary area; Square J 9/20; depth 8′ 6″ Antler fragment.

7857a. Mound F; Great Granary area; Square H 9/23; depth 4′ 6″. 3 antler fragments.

2389. Mound F; Trench III; Square N 9/10; depth 14′ 9″. Lower jaw fragment, left ramus with Pm. 2, 3 and M. 1, 2.

7849a. Mound F; Trench III; Square N 9/15; depth 10′ 3″. "From a very fragmentary jar". Antler fragment.

10341. ? Antler fragment.

10368. Mound F; Trench IV, Square I 14/14; depth 7′ 6″. 4 antler fragments.

I have carefully compared the antler fragments excavated at Harappa with those of *C. duvauceli* in the Indian Museum collection and have no hesitation in assigning them to this species. In none of the fragments is the basal part preserved and it cannot, therefore, be surmised whether these fragments are of normally shed antlers or removed from animals that had been killed.

No. 3380, which was found in a "fragmentary jar" is, as noted above, highly polished and the tip is rounded, while 7849a, which was also found in a jar is very fragile and highly impregnated with gypsum. The circumference of fragment No. 10341 near the base is *ca.* 5 inches and this shows that the antler is of a fully adult specimen[1].

The lower jaw fragment with the premolars 2, 3 and molars 1, 2 agrees with a recent specimen in the Indian Museum in all respects. I reproduce photographs of these specimens on Plate IV (figs. 1, 2).

*Distribution.*—According to Lyddekker[2] the range of this species "is restricted to India, not extending eastward of the Bay of Bengal or to Ceylon. Along the foot of the Himalaya it embraces the tract from Upper Assam in the east to the Kyarda Dun west of the Jumna, Assam, a few localities in the Indo-Gangetic plain from the Eastern Sundarbans to Bahawalpur, Rohri in Upper Sind, and parts of the extensive area lying between the Ganges and Godaveri valleys as far eastwards as Mandla."

[1] For comparison of measurement see T. Bentham—*Illustrated Cat. Asiat. Horns and Antlers in the Indian Museum*, pp. 85, 86 (Calcutta, 1908).

[2] Lyddekker, R.—*Cat. Ungulate Mam. Brit. Mus.*, IV, pp. 95, 96 (1915).

TYLOPODA.

Family : SUIDÆ.

### **Sus cristacus** Wagner var. **domestitus** Rolleston.

D. S. 27. Af; (*D. R. S.*, coll.); depth 5′. 3rd left upper.

D. S. 15. ? (*D. R. S.*, coll.). Lower jaw fragment with left M. 2.

Mound F; Great Granary area; Square M 11/16, 17, 21; depth 21′ 6″. 1st and 2nd lower left Molars.

2574. Mound F; Trench IV; Square N 9/9; depth 17′ 11″. Fragment of 3rd M. right.

3929. Mound F; Great Granary area; Square I 9/7; depth 10′ 2″. Lower jaw fragment with 3rd M. right.

3759. Mound F; Great Granary area; Square I 9/8; depth 5′ 3″. Upper jaw fragment with Pm. 4 and M. 1 and 2; 2 lower jaw fragments with Pm. 4 and Molar 1 and Pm. 4 respectively; fragments of radius.

2596. Mound F; Great Granary area; Square I 9/8; depth 6′ 4″. Lower jaw fragment, left ramus with M. 2, 3.

Mound F; Trench I; Square M 11/17, 22; depth 21′ 6″. Upper jaw fragment with M. 1, 2.

Mound AB; Extension of Pits I, II; Square Q 24/3; depth 6′-9′. Metatarsal of 4th toe.

Mound F; Great Granary area; Square J 7/20. Metacarpal of 3rd finger, right.

Mound F; Great Granary area; J 9/5, 10, 15; depth 1′-3′ 6″. Right calcaneum.

H/C. "Deep digging in cemetery Site". Upper jaw fragment with right molars 1, 2.

F V/IV. ? Fragment of lower jaws with incisors 1, 2 of each side and bits of canine.

G 10212. ? Scapulas right and left, almost complete and 3rd right metatarsal. 1st, 2nd thoracic and 1st sacral vertebral fragments.

H 483. Cemetery H; Square S 34/6; depth 3′ 8″. Rib fragments and phalanx of 5th toe.

J 12/24. ? Rib fragments.

I 9/10, 22. ? Metacarpal of 3rd finger, right.

P II/83. ? Rib fragments.

As there has been a considerable difference of opinion amongst the various authorities in reference to the existing Asiatic species of the genus *Sus* Linn. it would be useful to preface my remarks about the Harappa pig with a short summary of the literature on the subject. The common Indian form, as the name indicates, was described as *S. cristatus* by Wagner[1] in view of "a crest of lengthened black bristles from the nape along the back". De Blainville[2] could not find any differences of morphological importance between the European wild boar—*S. scrofa* Linn. and the Indian *S. cristatus*, and Gray[3] confirmed this view in so far as the skulls of the two forms are concerned. Rütimeyer[4] believed *S. indicus* (=*S. cristatus*) to be the representative of a distinct stock, if not a

[1] Wagner, J. A.—*Munch. gel. Anz.* IX, p. 535 (1839).

[2] De Blainville, H. M. D.—*Osteographie des Mammifères*, IV, p. 129 (Paris, 1839-64).

[3] Gray, J. E.—*Proc. Zool. Soc. London*, p. 130 (1852).

[4] Rütimeyer, L.—*Neue Denkschr. naturf. Ges. Basel*, Teil IV, pp. 186-190 (1862).

distinct species. Nathusius[1] considered *S. vittatus* Müller & Schlegel, of the islands of Java, Borneo, etc., as the parent stock of *S. indicus*. Nehring[2] agreeing with Nathusius regarded *S. cristatus* to be only a continental form of the insular *S. vittatus*. Blyth[3] divided the Indian wild pigs into three species:—*S. bengalensis* Blyth from Bengal, *S. indicus* Gray with a wide range of distribution throughout India, Ceylon and Arakan, and *S. zeylanensis* Blyth from Ceylon. He distinguished the three species by the form of the skull and particularly by the breadth of its occipital plane; the skull of the Bengal species being the broadest and most convex and that of the Ceylon form the narrowest. He further added that the widely distributed *S. indicus* approximates in skull characters to the European *S. scrofa*. Jerdon[4] remarked that the Indian wild hog was as "worthy of specific distinction as many other recognised species". Rolleston[5] though he came to no definite conclusions about the specific differentiations of the various Asiatic species, concluded that "whilst *Sus cristatus*, *Sus leucomastyx*, *Sus vittatus* and *Sus timorensis* form a close connected group of *Suidæ non verrucosi*, with which again *Sus andamanensis* and *Sus papuensis* are to be allied, all these subspecies differ in points of considerable if not of specific value from *Sus verrucosus* of Java, from *Sus celebensis*, and finally from *Sus scrofa* of the Palæarctic region as well as from non-verrucose *Sus barbatus* of Borneo". He further added notes on two skulls of the domestic pig from Monghyr, Bengal, and designated this form as *S. cristatus* var. *domesticus*. Forsyth-Major[6] combined the Indian forms with *S. vittatuss*, and assigned it a very wide range from Sardinia to New Guinea and from Japan to the South-West Africa. Lyddekker[7] from his studies on the recent and fossil forms was "inclined to continue to apply separate names to the Indian, *S. cristatus*, the Javan (etc.) *S. vittatus* and the smaller *S. andamanensis*, even if some of the forms indicate a more or less complete transition between them". He further remarked that "it is highly probable that the *S. verrucosus*, *S. vittatus* (including *S. cristatus*) and *S. andamanensis* groups are descendants of some of the three medium or large forms of Siwalik pigs with simple molars; and the undoubted existence of the three fossil forms renders it, *prima facie*, probable that the existing Asiatic species (exclusive of *S. barbatus* and *S. salvanius*) are more than two in number". Sclater[8], Blanford[9] and more recently Wroughton[10] and Lyddekker[11] all consider *S. cristatus* to be distinct from *S. scrofa*. Blanford distinguished the Indian from the European species by its much more developed crest of

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[1] Nathusius, H. V.—*Vorstudien für Geschichte und Zucht der Hausthiere Zunachst am Schweineschaedel*, p. 175 (Berlin, 1864).

[2] Nehring, A.—*Katalog Saugethiere Zool. Samm. Kongl. Landwirth. Hochschule Berlin*, p. 54 (Berlin, 1886).

[3] Blyth, E.—*Journ. Asiat. Soc. Bengal*, XXIX, pp. 105-106 (1860).

[4] Jerdon, T. C.—*The Mammals of India*, p. 242 (Roorkee, 1867).

[5] Rolleston, G.—*Trans. Linn. Soc. London* (Ser. 2) I, Zool., pp. 21-286, pls. xli-xliii (1877).

[6] Forsyth-Major, C. J.—*Zool. Anz.* VI, pp. 295-300 (1893).

[7] Lyddekker, R.—*Mem. Geol. Survey Ind., Pal. Ind.* (Ser. X) III, pp. 50, 99 (1884).

[8] Sclater, W. L.—*Cat. Mampualia Ind. Mus.*, II, pp. 193, 194 (1891).

[9] Blanford, W. T.—*Faun. Brit. Ind. Mammalia*, pp. 560-562 (1891).

[10] Wroughton, R. C.—*Journ. Bombay Nat. Hist. Soc.* XXI, p. 1194 (1912).

[11] Lyddekker, R.—*Cat. Ungulate Mam. Brit. Mus.* IV, pp. 318-320 (London, 1915).

black bristles and proportionately greater size and complexity of the last molar of each jaw. He also considered the tame pig of India to be "doubtless derived from the wild animal". Stehlin[1] from his detailed work on the teeth of the recent and fossil Suidæ considered *S. cristatus* to be a "sehr nahestehende Form" of *S. scrofa*, while Pira[2] considered it to belong to the "*vittatus*—Typus"; this group, according to this author, has a wide range in India up to the Himalayas, China, Indo-China, Tenasserim; in the insular areas in Ceylon, Andamans, Nicobars, Sumatra, Java and Flores up to Timor, and in Japan and Formosa. Duerst (*loc. cit.*, p. 355) following Nehring (1886) considered *S. cristatus* to only a "continental variety" of *S. vittatus* and proposed "to employ for the South Asiatic pig the general name of *S. vittatus*". The Anau remains, he considered to be the oldest known of the "Torfschwein" or the turbary pig, *S. palustris* Rütimeyer, which first appears in the Swiss pile-dwellings during the later Neolithic period, and is derived from *S. vittatus*. Keller[3] had in this connection remarked a few years earlier that *S. palustris* must exist in a subfossil condition in Central Asia, as it came at a very early period into Europe from Asia. In reference to the domestic pigs Max Weber (*loc. cit.*, p. 551) after discussing the three groups of recent forms concluded that these originated from the *scrofa-vittatus* forms. The European types are to be derived from *S. scrofa* and the Asiatic from *S. vittatus*. A certain amount of admixture amongst the two groups has also to be taken into consideration.

The material at my disposal is not sufficient for a detailed consideration of the various forms concerned, but following Rolleston, Lyddekker, Blanford and Wroughton I consider the common Indian boar to be *Sus cristatus*, and adopt for the domestic pig of India, derived from it, Rolleston's varietal name *domesticus*.

The remains of the Harappa pig are all very fragmentary and do not allow of a detailed comparison without other species, but after a careful examination of the bones and teeth I have no hesitation in referring them to the domestic race of the Indian pig *S. cristatus*. All the bones, as for example the scapulæ, the calcaneum and the phalanges are rather small and indicate that they belong to young individuals. I give below a series of measurements of these bones and for comparison have included measurements from the skeleton of a domestic pig in the Indian Museum.

*Measurements (in millimetres).*

| — | Length. | Proximal width. | Distal width. |
|---|---|---|---|
| Scapula— | | | |
| Harappa specimen, right | 186 | 35 | 103 |
| „ „ left | 186 | *ca.* 35 | *ca.* 102 |
| Indian Museum specimen, right | 233 | 38 | 120 |
| „ „ „ left | 232 | 37 | 119 |

[1] Stehlin, H. G.—*Abhandl. Schweiz. paläontol. Ges.* XXVI, p. 66.

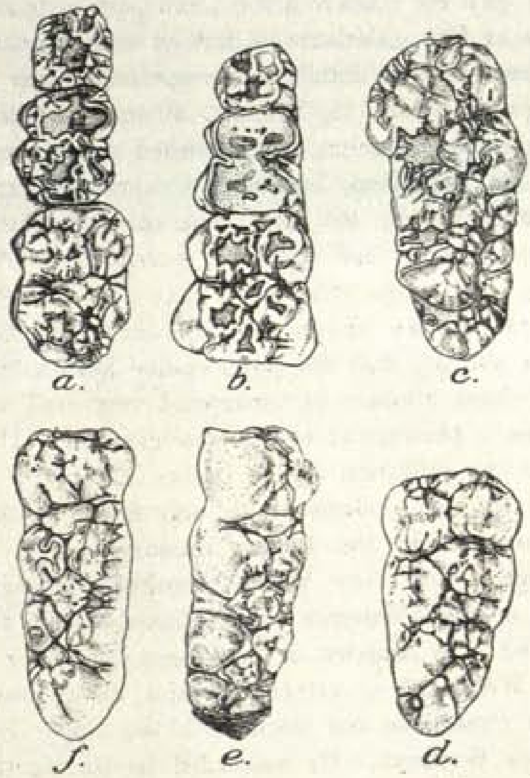
[2] Pira, A.—*Zool. Jahrb., Suppl.* X, p. 386 (1909).

[3] Keller, C.—*Die Abstammung der ältesten Haustiere*, pp. 18, 102 (Zurich, 1902).

*Measurements (in millimetres)*—contd.

| — | Length. | Proximal width. | Distal width. |
|---|---|---|---|
| Calcaneum— | | | |
| Harappa specimen | 86 | 32 | 21 |
| Indian Museum specimen | 94 | 36 | 21 |
| Metacarpal 3rd finger— | | | |
| Harappa specimen | 50 | 17 | 15 |
| Indian Museum specimen | 72 | 23 | 21 |
| Metatarsal 3rd toe— | | | |
| Harappa specimen | 76 | 21 | 15 |
| Indian Museum specimen | 82 | 23 | 18 |

The molar teeth resemble those of a domestic pig in the Indian Museum (Text-fig. 2); those of the Indian Museum specimen are more worn than those excavated at Harappa.




TEXT-FIG. 2. *Sus cristatus* Wagner var. *domesticus* Rolleston. (*a*) Left premolar 1 and molars 1, 2 from upper jaw fragment, No. 3759 excavated at Harappa; (*b*) the same teeth as in *a* of a specimen in the Indian Museum; (*c*) Left molar 3 of upper jaw from Harappa, No. D. S. 27; (*d*) the same tooth as in *c* of a specimen in the Indian Museum; (*e*) right molar 3 of lower jaw from Harappa, No. 3929; (*f*) the same tooth as in *e* of a specimen in the Indian Museum. All the figures are natural size.

Family: CAMELIDÆ.

**Camelus dromedarius** Linnæus.

The One-humped Camel.

(Plate VII, figs. 1-4.)

Mound AB; Extension of Pits I, II; Square I 8/10; depth 5′ 9″. . "Out of a jar." Shaft of left radio-ulna.

954. Square B/n; depth 16′. Left scapula very incomplete.

D. S. 30. A(e). (*D. R. S.* coll.). ? 1st phalanx of 3rd left finger.

The three remains of the Camel from Harappa are very fragmentary and their identification has been a matter of some difficulty.

The radio-ulna is of the left side but both its end-portions are missing. The shaft itself is not quite straight, but moderately arched; its outer surface is convex, while the inner is flattened and slightly concave near the middle. The total length is 435 mm., maximum diameter of the proximal end 60 mm., maximum diameter near the middle 51 mm., maximum diameter of the distal end 72 mm., these measurements correspond very closely with those of a recent specimen of *C. dromedarius* in the Indian Museum. Lesbre's[1] description of this structure "Le radius est tres allongé et doublement courbé dans sa longneur, sur plat et sur champ, de telle sorte qu'il est concave à son profil postérieur et à son bord externe. La partie externe de sa face antérieure se fait en outre remarquer par un certain aplatissement" applies in every detail to the specimen from Harappa. A photograph of the Harappa specimen (Pl. VII, fig. 3) and another (Pl. VII, fig. 4) of the specimen in the Indian Museum are published for reference.

The scapula is 430 mm. long, but as the supra-scapular portion is missing, its length must have been over 480 mm. The coracoid portion and the greater part of the spine are missing, and it is not possible, therefore, to be definite about their structure, but I have little doubt that it is the left scapula of *C. dromedarius*. The ventral surface shows the concavity in the proximal portion, the glenoid cavity is similar, and the postscapular fossa which is much broader than the prescapular fossa appears to correspond very well with that of *C. dromedarius*. I reproduce a photograph of this specimen (Pl. VII, fig. 1) and of one (Pl. VII, fig. 2) from the collection of the Indian Museum.

The fragment of the 1st phalanx of 3rd left finger of the fore-leg resembles that of a recent specimen in the Indian Museum.

According to Cope,[2] "the New World furnished the camel to the Old" as there is no evidence of the occurrence of the Camel-line in the Old World prior to the late Miocene, while in America as *Pantolestes* Cope they were present during the Eocene epoch. Wortman[3] is rather doubtful about the tylopodan characteristics of the genus *Pantolestes* and starts with the Upper Eocene (Uinta formation) genus *Protylopus* Wortman. He succeeded in tracing the phylogeny of the Camel through various intermediate genera to *Camelus americanus* Wortman,

[1] Lesbre, F. X.—*Archiv. Mus. d'hist. Nat. Lyons*, VIII, p. 40 (1903).

[2] Cope, E. D.—*Amer. Naturalist*, XX, pp. 611-624 (1886).

[3] Wortman, J. L.—*Bull. Amer. Mus. Nat. Hist.*, X, pp. 93-142 (1898).

fossils of which were discovered in the Pleistocene beds of Italy Springs. According to Abel[1] the family became established in Asia since the lower Pliocene and during the Ice Age reached Siberia. Falconer and Cautley[2] described from the Siwalik Hills of Northern India a fossil camel, *C. sivalensis*, which they considered to be "nearly approaching the Indian species"; this form may probably have been the ancestral type of *C. bactrianus* Linn. from which the one-humped camel —*C. dromedarius*—was derived. Abel more recently[3] remarked that the origin of the Selenodontia is very doubtful, and it is just possible that they originated in the Eocene of Asia, whence they spread to America and Europe, and in each country developed further along specialised lines. Duerst (*l. c.*, pp. 383, 384) after referring to Nehring's discovery of *C. knoblochi* in later Pleistocene deposits in Lutschka near Sarepta on the Volga north of the Caspian, and of *C. alutensis* Stefanesku in Roumania, concludes that all the camels were descended from *C. sivalensis*. One of the branches of the two-humped reaching Western Asia and Eastern Europe developed into *C. knoblochi* and *C. alutensis* and probably the domestic race of the Anau Camel, while the other reached Africa and "formed the one-humped variety of Northern Africa and Arabia". Whatever view may finally prevail, there can be little doubt that the Indian one-humped Camel is the descendant of the Siwalik fossil form—*C. sivalensis*, and that probably its domestication was first brought about in India.

*Distribution*.—*C. dromedarius* has not so far been discovered in a feral state. It is, according to Sclater[4], "found domesticated in India, Afghanistan and Western Asia generally also in Northern Africa".

The remains of the Camel unearthed at Harappa, though scanty, seem to indicate that this animal had already been domesticated and was used by the Harappa people probably as a beast of burden.

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[1] Abel, O.—*Die Stamme der Wirbelthiere*, p. 808 (Berlin, 1919).

[2] Falconer, H. & Cautley, P. T.—*Asiat. Researches*, XIX, pp. 115-142, pls. xx, xxi (1835).

[3] Abel, O.—In Max Weber—*Die Säugetiere*, II, p. 561 (1928).

[4] Sclater, W. L.—*Cat. Mammalia Ind. Mus.*, II, p. 192 (Calcutta, 1891).

# INDEX.

MGIPC—M—III-9-54- 22-4-36—400.

## EXPLANATION OF PLATE I.

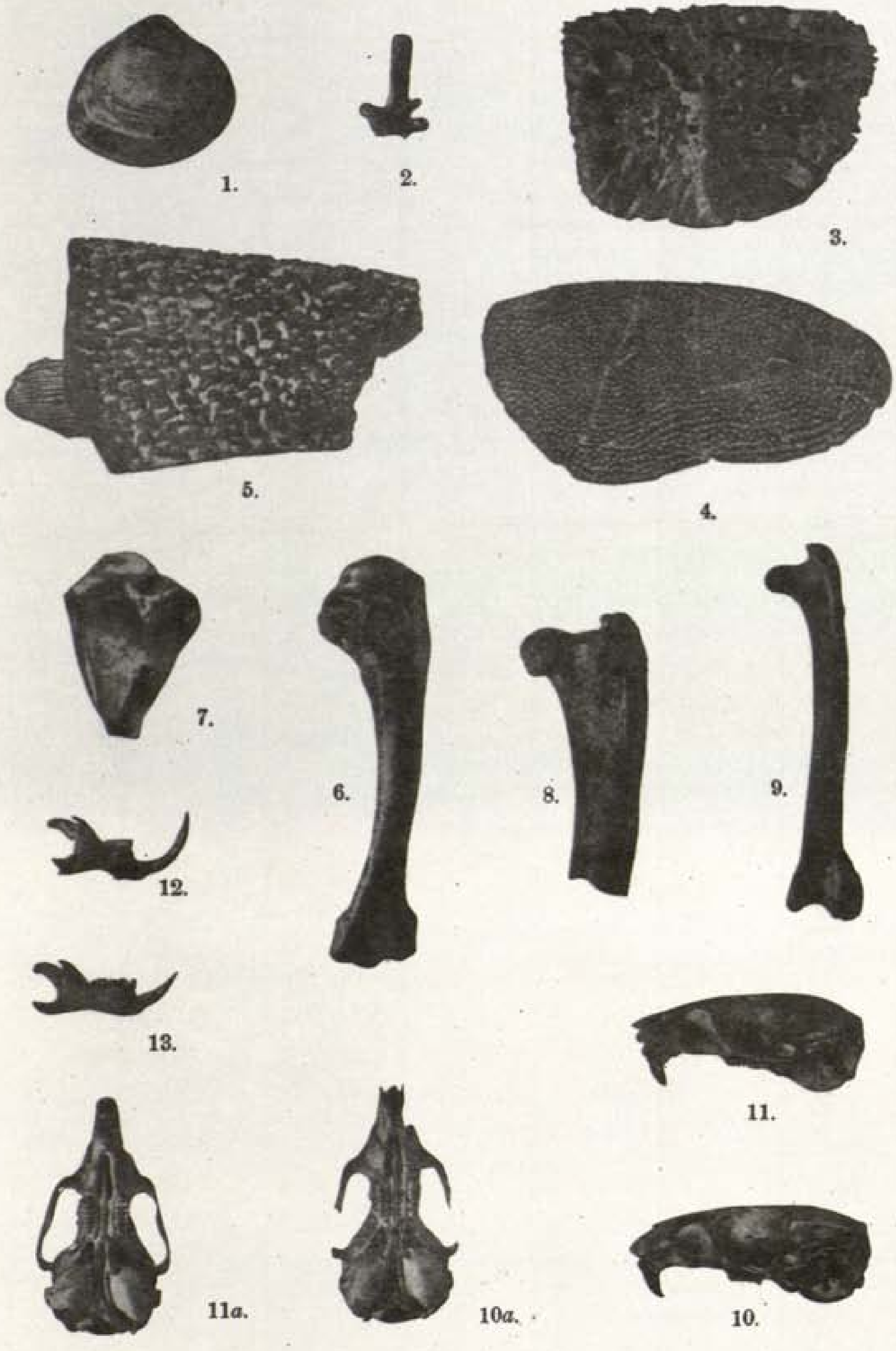
FIG. 1. *Parreyssia favidens* (Benson) var. *trigona* Benson. No. 3689. Right valve.
FIG. 2. *Varanus* sp. Lateral view of a caudal vertebra. No. 1400.
FIG. 3. *Gavialis gangeticus* (Gmelin). A dorsal scute. No. 7048.
FIG. 4. *Lissemys punctata* (Bonnaterre) forma *typica*. Left epiplastron. No. 5556.
FIG. 5. *Chitra indica* (Gray). Fragment of hypoplastron. No. 265.

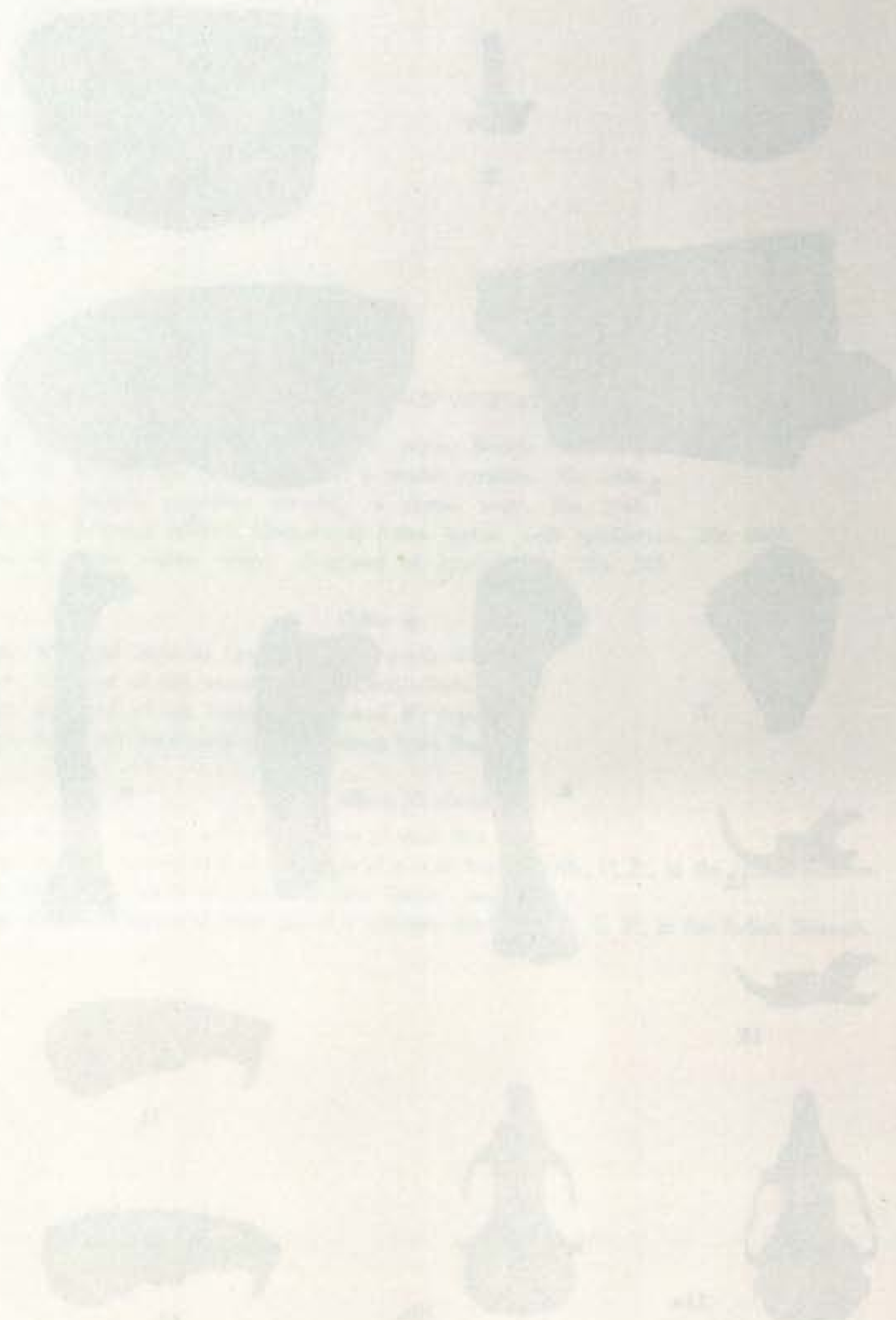
*Gallus* sp.

FIG. 6. Right humerus from Mound F; depth 6′-9′.
FIG. 7. Head of left humerus from Mohenjo-Daro.
FIG. 8. Head of left femur from Mound F; depth 6′-9′.
FIG. 9. A left femur of a recent specimen from Bengal.

*Tatera indica* (Hardwicke).

Figs. 10, 10*a*. Lateral and ventral views of skull (No. 805).
Figs. 11, 11*a*. Lateral and ventral views of a skull from Bareilly, U. P., in the Indian Museum.
Fig. 12. Right ramus of lower jaw (No. 7849*a*); fragmentary.
Fig. 13. Right ramus of lower jaw of a specimen from Bareilly, U. P., in the Indian Museum.


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## EXPLANATION OF PLATE II.

*Felis ocreata* Gmelin, race *domestica* Brisson.

Fig. 1. Dorsal view of a skull from the Indian Museum Collection.
Fig. 1*a*. Lateral view of the same skull.
Fig. 2. Dorsal view of the skull excavated from Mound F, No. 1202.
Fig. 2*a*. Lateral view of the same skull.

*Mungos auropunctatus* (Hodgson).

Fig. 3. Lateral view of skull excavated from Mound F, No. 7783a.
Fig. 4. Lower jaw from the same site.
Fig. 5. Lower jaw of a specimen in the Indian Museum Collection.
Fig. 6. Atlas vertebra from the same site.
Fig. 7. Axis vertebra from the same site.
Fig. 8. Right scapula from the same site.
Fig. 9. Right humerus from the same site.
Fig. 10. Right tibia, incomplete, from the same site.
Fig. 11. Right half of the pelvic girdle from the same site.

*Canis indicus* Hodgson.

Fig. 12. Lateral view of a skull excavated from the Area G.
Fig. 13. Lateral view of a skull from the old A. S. B. collection in the Indian Museum.
Fig. 14. Left ramus of the lower jaw from the Area G.
Fig. 15. Left ramus of the lower jaw in the Indian Museum.


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## EXPLANATION OF PLATE III.

*Canis pallipes* Sykes.

Figs. 1, 1*a*. Lateral and ventral views of a skull. No. 10797 (*d*), excavated at Harappa.
Figs. 2, 2*a*. Lateral and ventral views of a skull in the Indian Museum.
Fig. 3. Right ramus of a lower jaw. No. 10797 (*d*), excavated at Harappa
Fig. 4. Left femur. No. G. 289, excavated at Harappa.
Fig. 5. Left calcaneum. No. 10797 (*d*), excavated at Harappa.

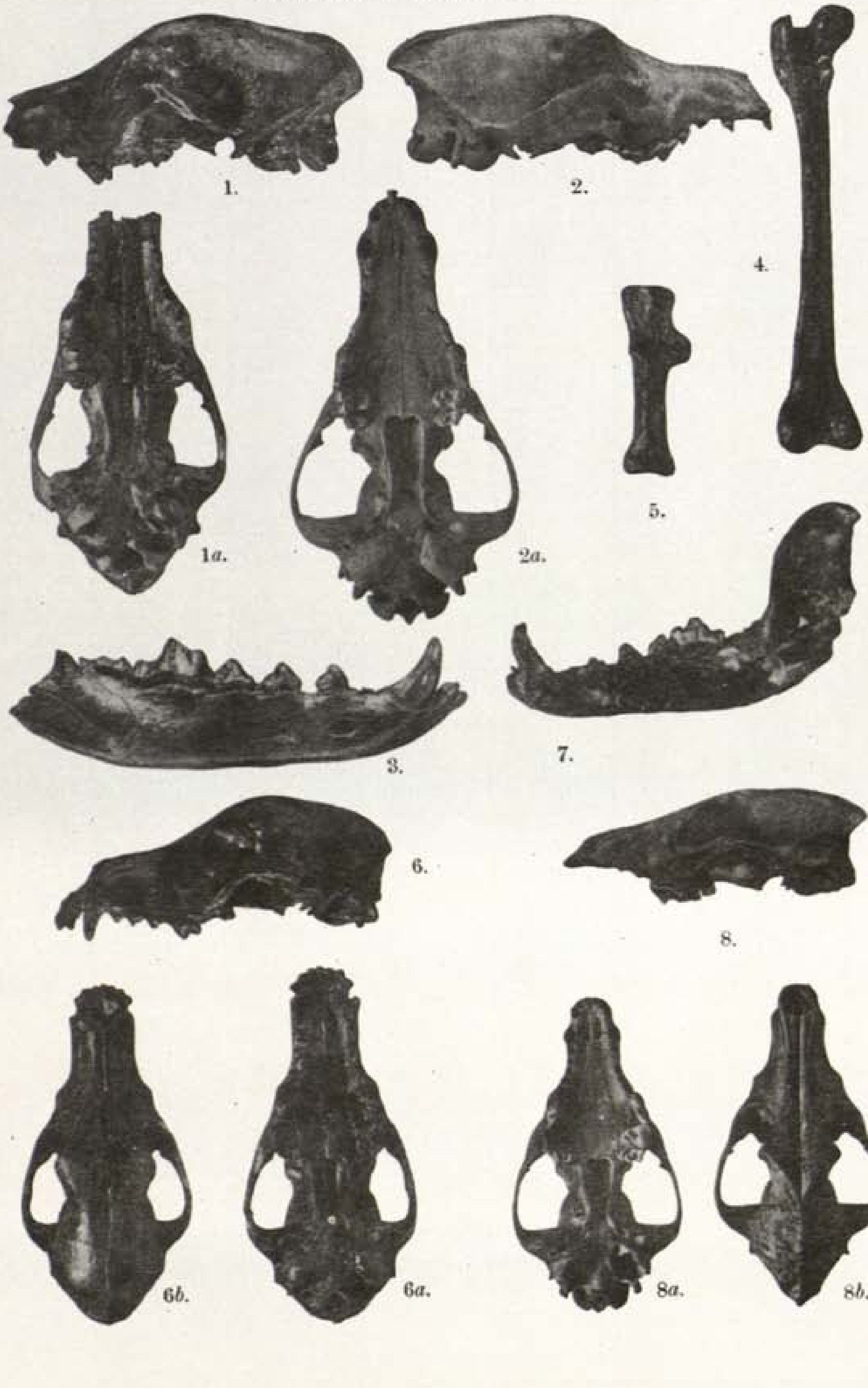
*Canis tenggeranus* Kohlbrugge, race *harappensis* nov.

Figs. 6, 6*a*, 6*b*. Lateral, ventral and dorsal views of skull from Mound AB.
Fig. 7. Left ramus of lower jaw.

*Indian Pariah Dog.*

Figs. 8, 8*a*, 8*b*. Lateral, ventral and dorsal views of a skull in the Indian Museum.

PLATE III.



## EXPLANATION OF PLATE IV.

*Cervus (Recurvus) duvauceli* Cuvier.

Fig. 1. Lower jaw fragment with premolars 2, 3 and molars 1, 2. No. 2389.

Fig. 2. Part of a lower jaw ramus of a recent specimen in the Indian Museum.

*Bos indicus* Linnæus.

Fig. 3. The two horns with the frontal region of a short-horned cattle. No. 10212.

Fig. 4. Right horn of a short-horned cattle from Mound F; Square M. 11/22.

Fig. 5. A lower jaw fragment of the right ramus. No. 7783*a*.

Figs. 6, 7. Atlas and axis vertebræ of the long-horned cattle. No. H. 503.

Figs. 8, 9. Two specimens of humerus of the short-horned and long-horned races, No. H. 483 and No. H/C, Cemetery site. The reduction for both the photographs is the same.

Fig. 10. Distal end of right radio-ulna with carpal bones of an animal of the long-horned race. No. 10008*a*.



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## EXPLANATION OF PLATE V.

*Bos indicus* Linnæus.

Fig. 1. Left 3rd-4th metacarpal of an animal of the short-horned race. No. H/C, Cemetery site.

Fig. 2. Right femur of an animal of the long-horned race. No. 10212.

Figs. 3, 4. Complete and distal fragment of 3rd-4th metatarsal of the short- and long-horned races. No. 10212 and from Mound F, Trench VI respectively.

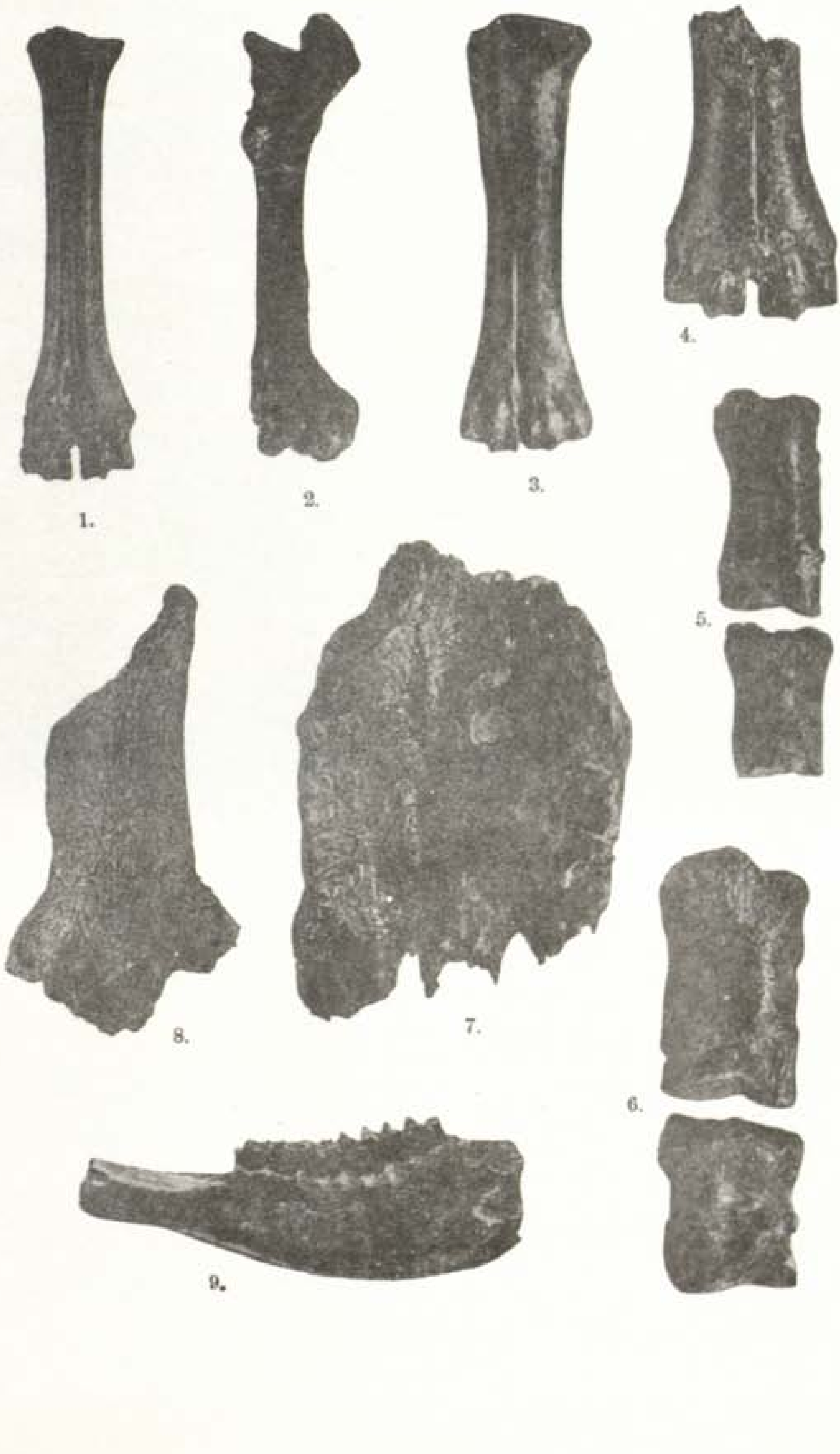
Figs. 5, 6. 1st, 2nd phalange of the short- and long-horned races. No. 10212 and from Mound F, Trench VI respectively.

*Bos (Bubalus) bubalis* Linnæus.

Fig. 7. Palatal part of a specimen. No. G. II/27.

Fig. 8. Fragment of a right horn from Mound G; Trench II; Square AM 40/21.

Fig. 9. Fragment of left ramus of lower jaw. No. 5440*a*, *b*, *c*.



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## EXPLANATION OF PLATE VI.

*Capra ægagrus* Gmelin, race *indicus*.

Fig. 1. Lateral view of fragment of right ramus of lower jaw. **No. H. 507.**

Fig. 2. Distal end of left humerus. No. H. 307*b*.

Fig. 3. Distal half of right 3rd-4th metacarpal. No. 7846*a*.

Fig. 4. Distal fragment of right 3rd-4th metatarsal. No. 3687.

Fig. 5. Left horn-core fragment (No. D. S. 18).

*Ovis vignei* Blyth, race *domesticus*.

Figs. 6, 7. Lateral and posterior views of skull. No. H. 501*f*.

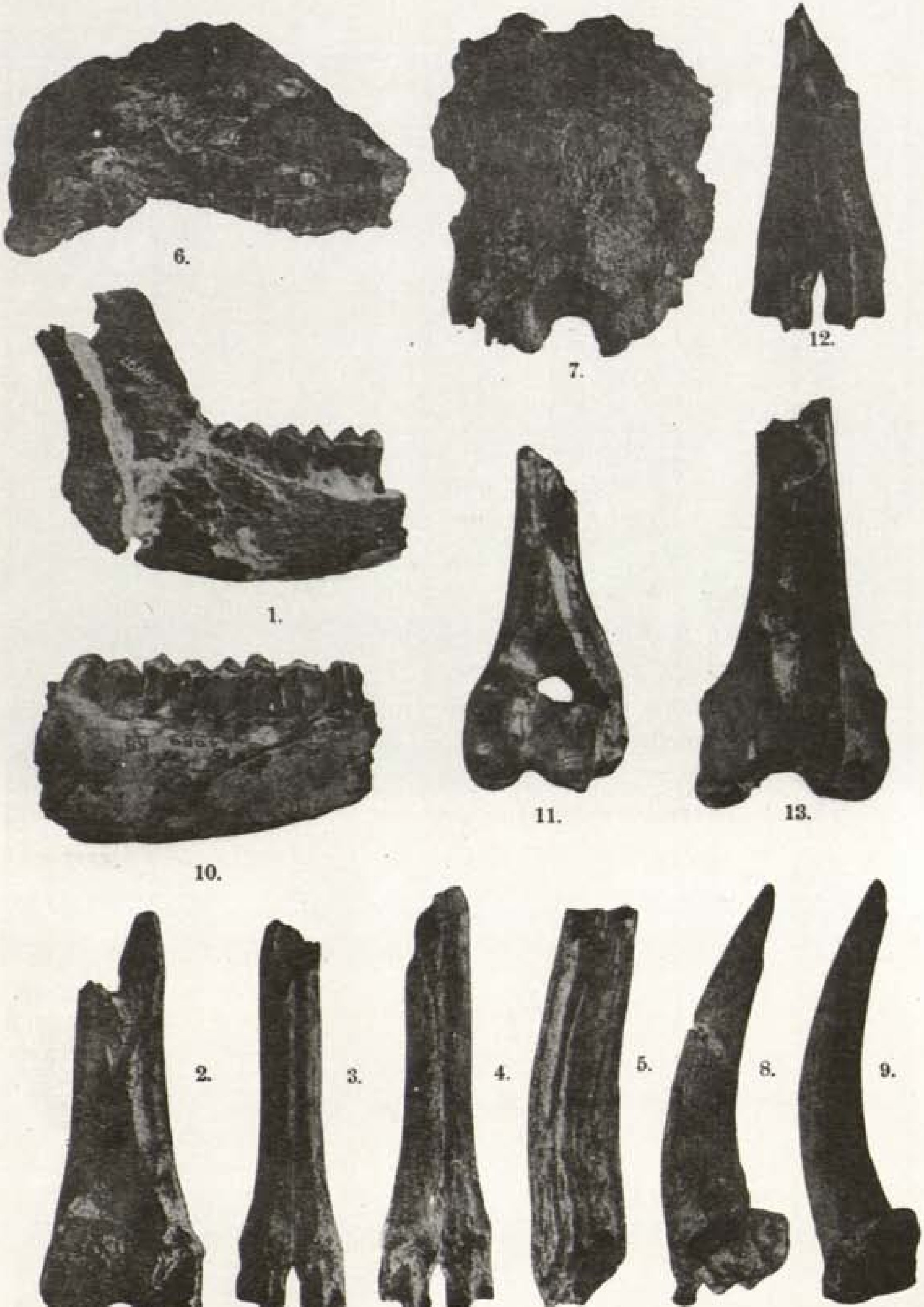
Figs. 8, 9. Two horn-cores. No. 3905.

Fig. 10. Fragment of right ramus of lower jaw. No. 4989*a*.

Fig. 11. Distal fragment of left humerus. No. G. 10212.

Fig. 12. Distal fragment of right 3rd-4th metacarpal. No. (D. S. 27), Af.

Fig. 13. Distal fragment of left femur. No. G. 10212.


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## EXPLANATION OF PLATE VII.

*Camelus dromedarius* Linn.

Fig. 1. Left scapula, No. 954, fragmentary.

Fig. 2. Left scapula of a recent specimen in the Indian Museum.

Fig. 3. Left radio-ulnar shaft from Mound AB, excavated from a depth of 5′ 9″.

Fig. 4. Left radio-ulna of a recent specimen in the Indian Museum.

*Rhinoceros unicornis* Linn.

Fig. 5. Fragmentary right scapula from Mound F, excavated from a depth of 8′ 7″—11′ 10″.

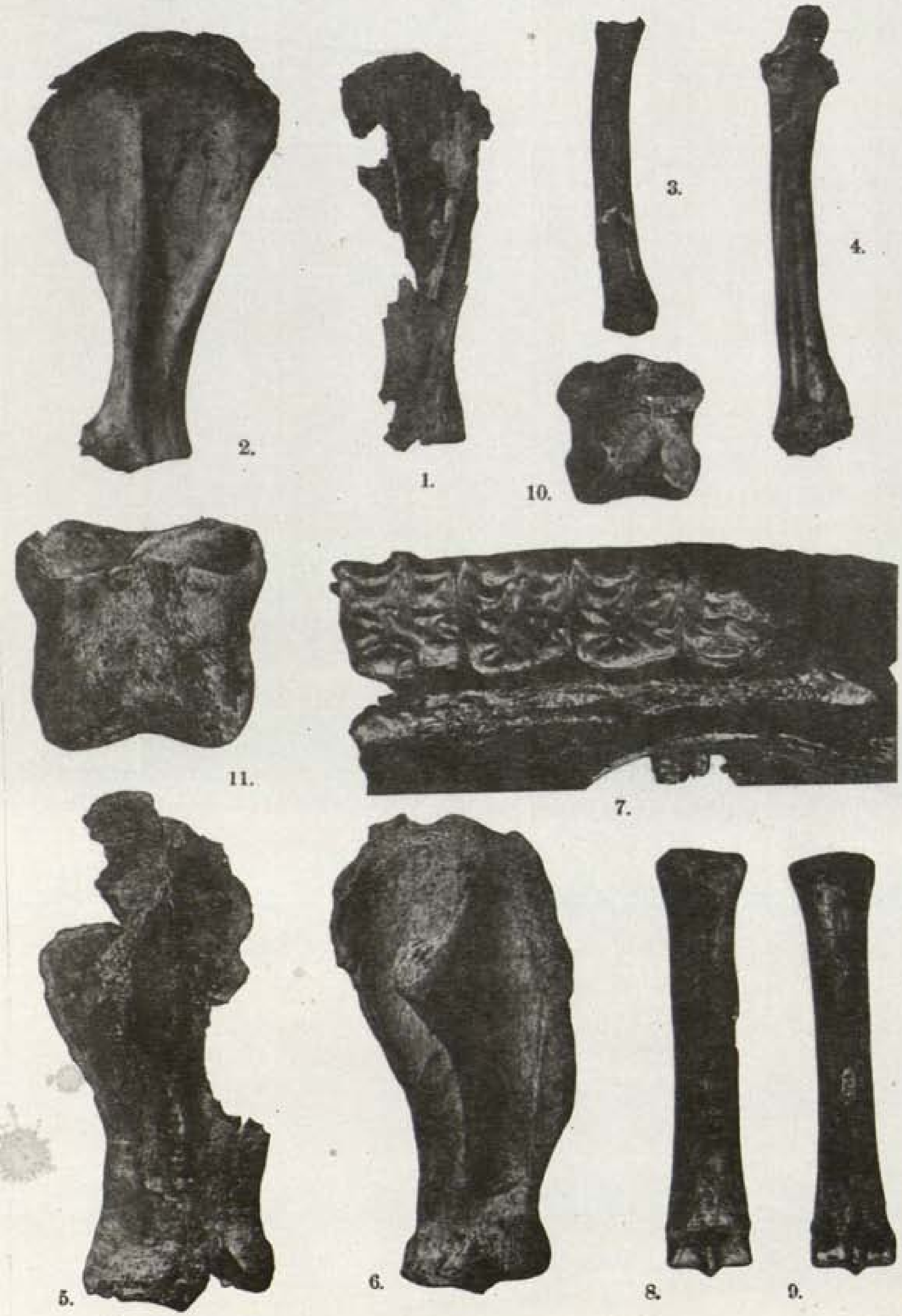
Fig. 6. Right scapula of a specimen in the Indian Museum.

*Equus asinus* Linn.

Fig. 7. Maxillary portion of palate with 4th premolar and 1-3 molars; No. 954.

Figs. 8, 9. Two 3rd right metacarpals.

Figs. 10, 11. Two specimens of 2nd phalanx of right hind-leg and right fore-leg of different sizes (*D. R. S.* coll.). No. D. S. 40 and 29.


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